

Gulf of Tadjoura

Gulf of Aden

D J I B O U T I

Djibouti

0 1 2 Kilometres

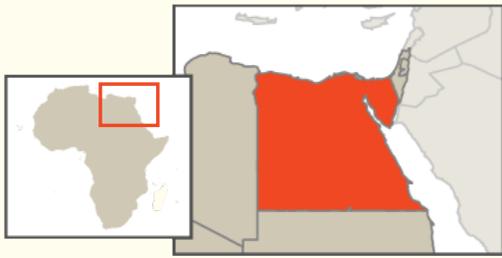


12 Apr 2006

capital city. Droughts during recent decades and desertification exacerbated by overgrazing have reduced the viability of pastoral life. This, along with high rural water insecurity, has helped to drive many rural residents to villages and cities—many of them settling in the capital.

Water availability in the capital is better than in rural areas, but supply and sanitation are problems there as well; the rapidly growing population will make the supply issue worse. Improving access to water in the rural areas is a way to address poverty and health issues in the countryside and at the same time reduce the rural-to-urban migration that is straining the capital city's infrastructure. A recent partnership between the European Union, UNICEF, and Djibouti's Ministry of Agriculture should bring clean, safe water to 25 000 of Djibouti's poorest rural residents.





Arab Republic of Egypt

Total Surface Area: 1 001 449 km²
Estimated Population in 2006: 75 437 000



Egypt consists of a large desert plateau, interrupted only by the Nile River Valley and Delta, which constitute less than five per cent of the nation's territory. Approximately 97

per cent of the population occupies these latter lands, reaching population densities of nearly 1 200 inhabitants per square kilometre (FAO 2005). Located strategically in the northeastern corner of Africa, Egyptian coasts border both the Mediterranean Sea and the Red Sea.

Important Environmental Issues

- Urbanisation and Pollution
- Soil Erosion and Land Degradation
- Threats to Biodiversity



Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

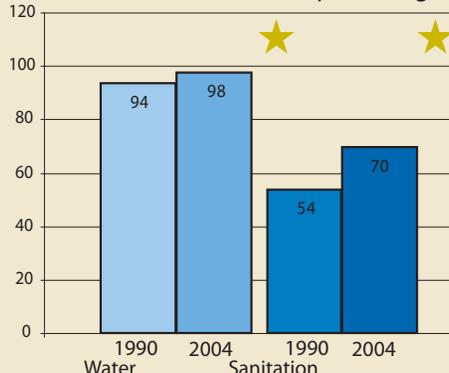
Egypt is primarily a desert country where aridity is a major problem. Soil fertility has declined because of over-cultivation and agricultural land has been lost to urbanisation and desert winds. However, Egypt has some positive environmental changes, including an increase in protected areas, access to improved water sources and sanitation, and a decrease in slum population percentage in urban areas.

★ Indicates progress

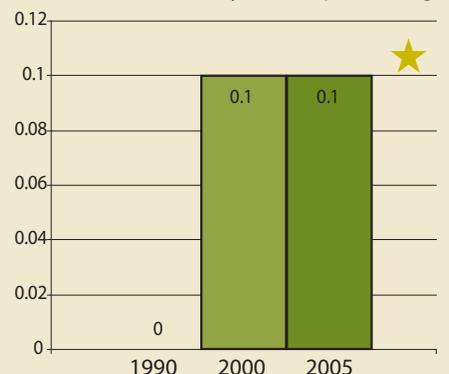
Protected area to total surface area, percentage



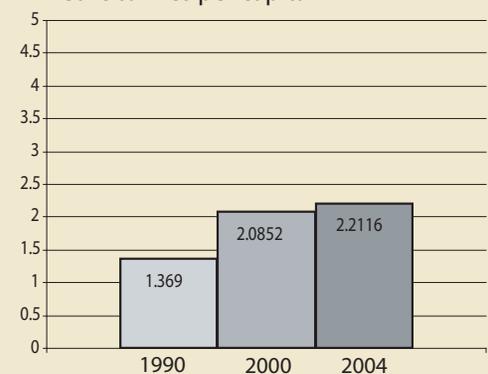
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Land area covered by forest, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



Slum population as percentage of urban

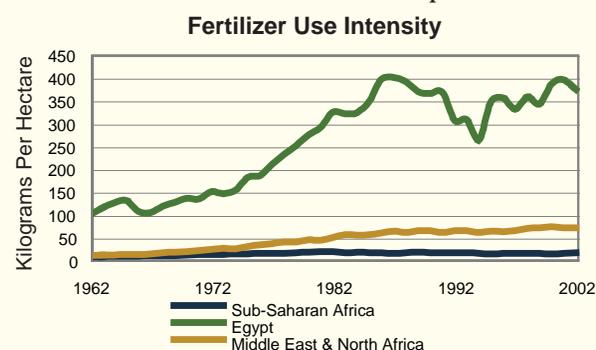


Egypt is the driest country in Africa with an annual precipitation of 51 mm/year on average and has hardly any forest area.

Urbanisation and Pollution

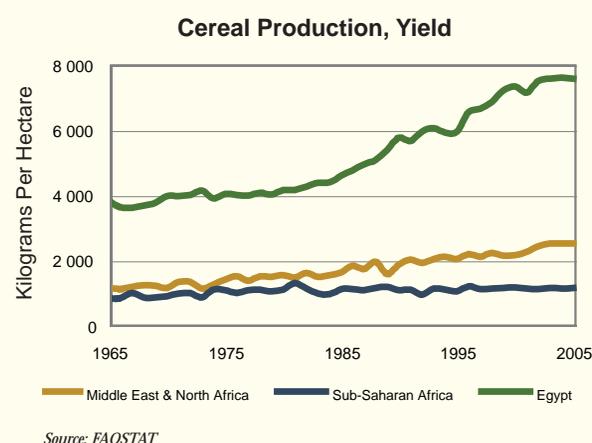
Cairo is one of the most populous cities in the world with 11.1 million residents in 2005 (UN 2006). With increasing population growth and industrialisation, pollution has become a growing problem in Egypt's urban areas. Vehicle emissions and solid municipal waste burning are the largest contributors to air pollution, and the number of vehicles is continuing to increase by ten per cent each year (SoE 2006). Water pollution is predominantly a result of agricultural runoff, although industrial waste water effluent is also a problem. Egypt uses more fertilizer and pesticides per hectare of cropland than any other African country (FAO 2005), forcing

the government to advocate organic farming and mechanised weed control to reduce pollution.



Soil Erosion and Land Degradation

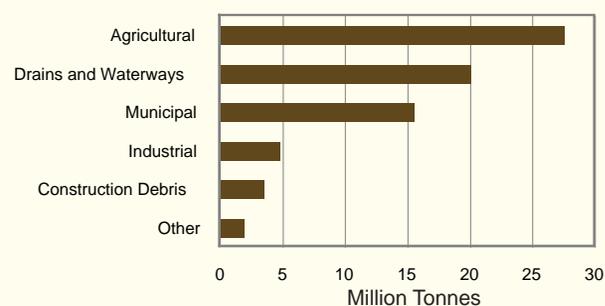
Consisting mostly of hyper-arid lands that are highly vulnerable to desertification, Egypt cultivates a very small percentage of its land (SoE 2006). Virtually 100 per cent of this cropland is irrigated (FAO 2007), contributing to annual cereal yields that are the highest in Africa (FAO 2005). However, pressures on agricultural land, including urban encroachment, waterlogging and soil salinity, pollution, and erosion from intensive farming have contributed to degradation and exacerbated the land scarcity problem. In some areas north and northeast of the Nile Delta, production losses from land degradation are estimated at eight per cent (SoE 2006).



Threats to Biodiversity

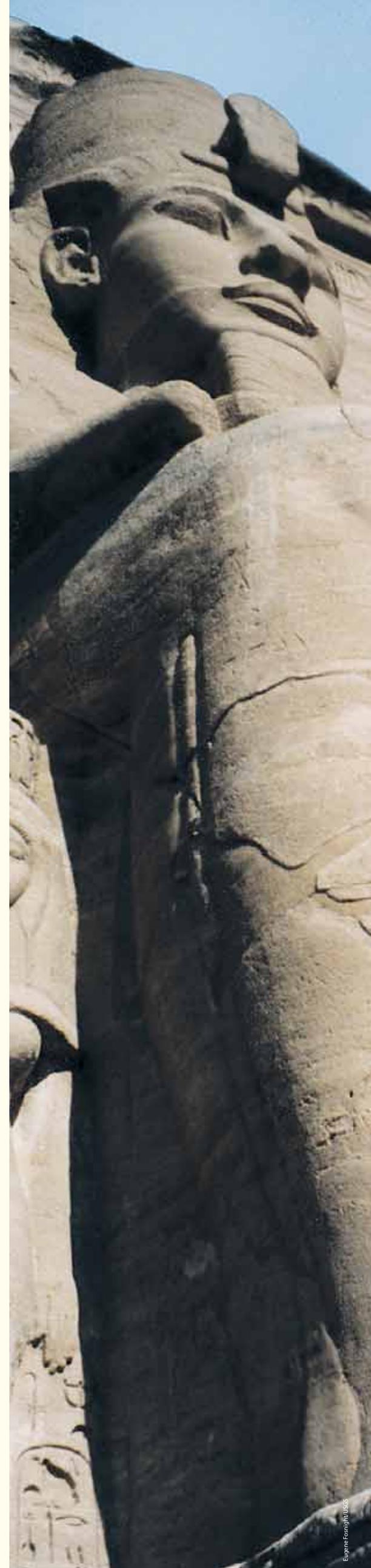
Much of Egypt's biodiversity is associated with the oases, marshes, mangroves, and other wetlands of the Nile River system. Habitat loss due to high population density in these areas is the primary

Solid Waste Production by Source, 2005

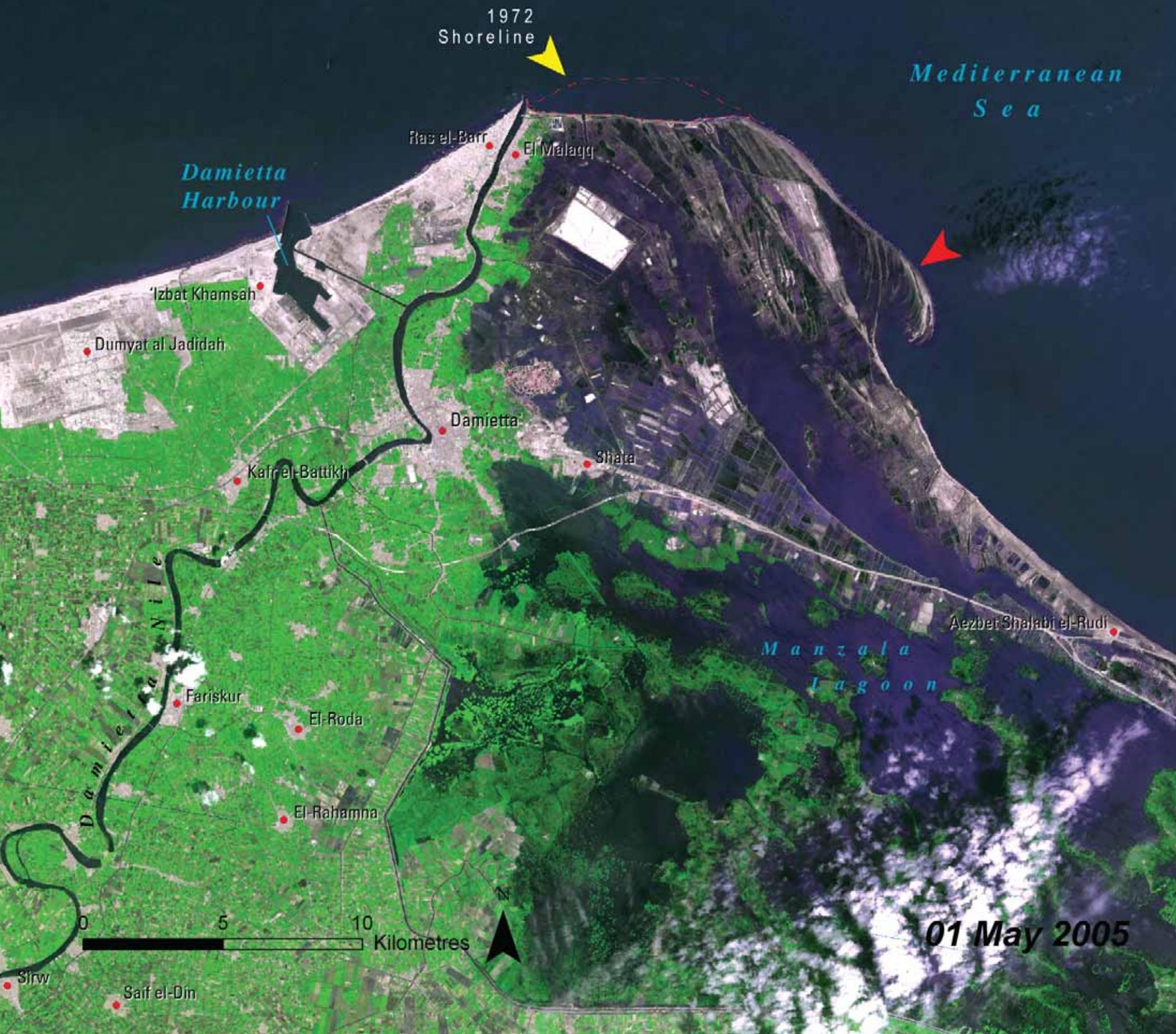


threat to wildlife, but escalating levels of land, air, and water pollution are also problems. Nearly 38 per cent of mammal species are critically endangered or vulnerable (SoE 2006).

Egypt's coral reefs are the largest in Africa and account for 1.34 per cent of global reef area (Spalding and others 2001), attracting millions of international tourists to the region. However, coastal ecosystems are threatened by pollution from solid waste and chemical residues from agricultural, industrial, and urban development. The Egyptian government has declared five marine protectorates, including several areas along the Sinai Peninsula and the Red Sea coast (SoE 2006).



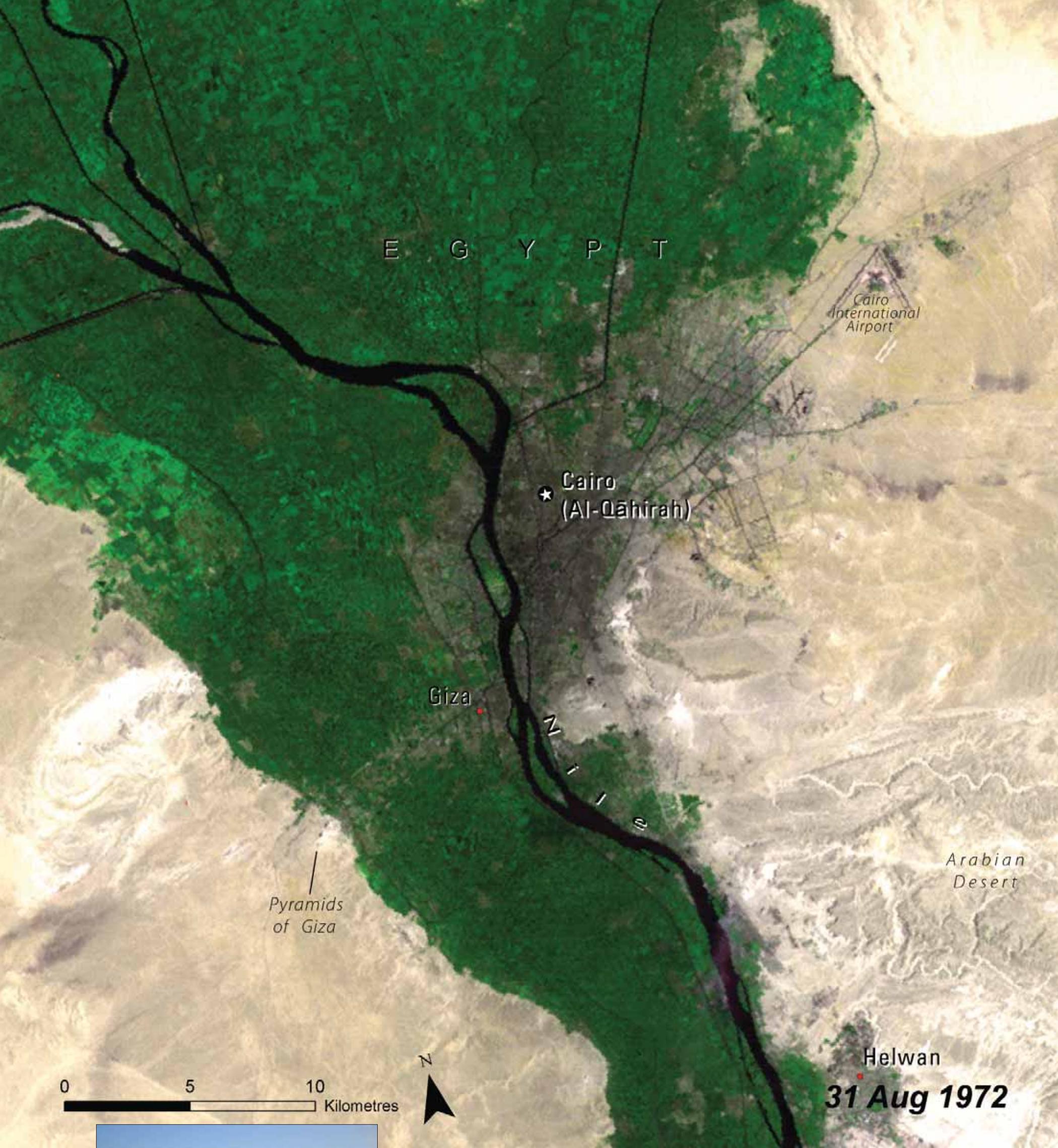
E G Y P T



them (yellow arrow). While there are local areas of accretion such as the Damietta Spit (red arrow), on balance the delta is shrinking.

Prior to the construction of the Aswan High Dam, fresh water from annual floods influenced salinity and circulation patterns up to 80 km offshore from the delta. In contrast, current discharge patterns allow salt water from the Mediterranean to reach dams up to 26 km inland. Diminished freshwater and sediment delivery to the delta also affects the ecology of coastal lagoons, soil fertility, and salinisation of irrigated land. Coastal protection structures, regulation of irrigation, and increased groundwater exploitation may mitigate the delta's decline, but the current rate of population growth threatens to outstrip these measures.



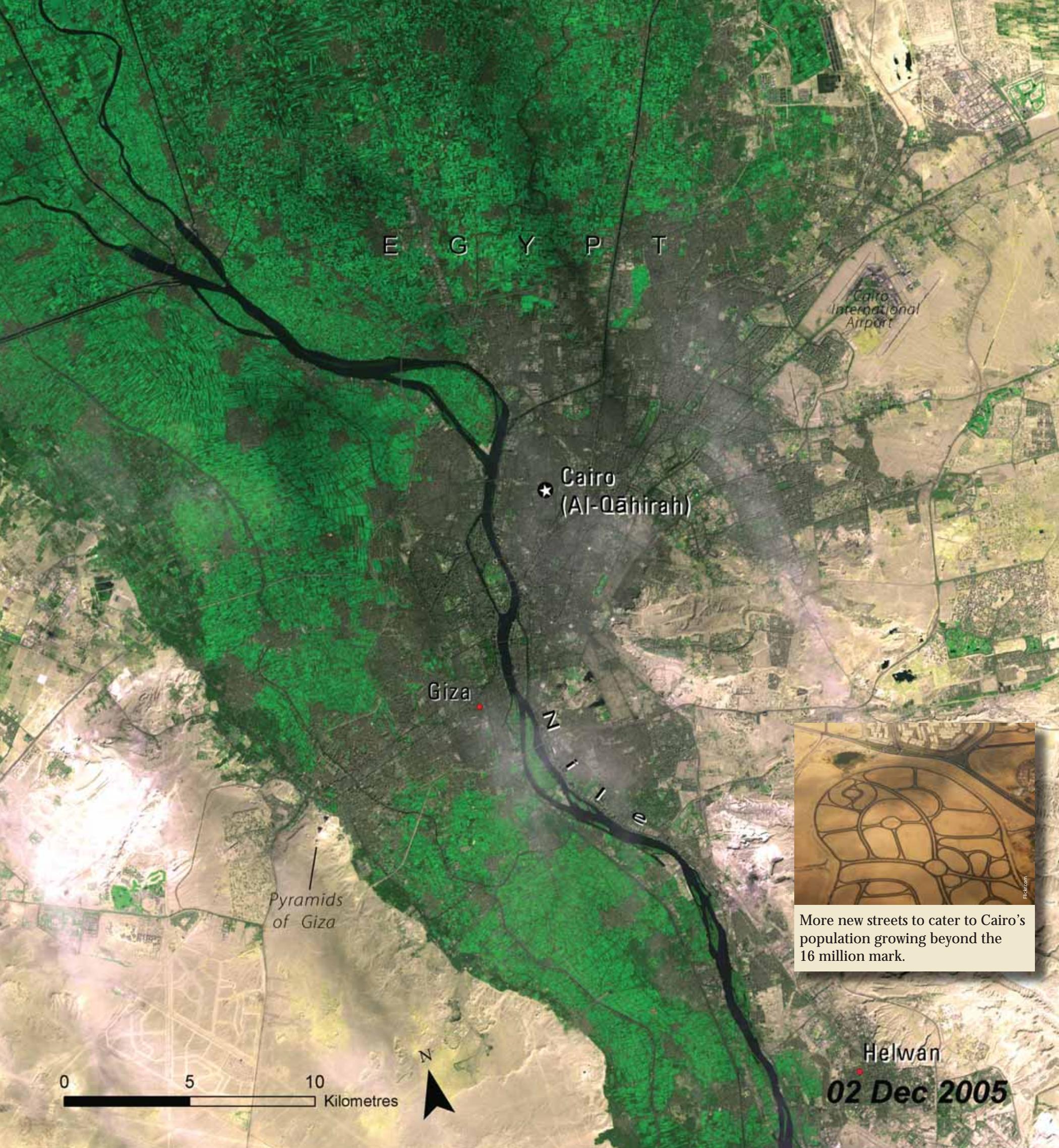


31 Aug 1972

Megacity Growing in the Desert: Cairo, Egypt

Cairo is the largest city in Africa, ranked by urban population, and Egypt is the third most populous country. In 1850, Cairo's population was only 250 000; 80 years later it had reached one million. Growing continuously, the population of the Cairo metropolitan area increased from less than six million in 1965 to more than ten million in 1998. Estimates of the city's current population vary widely, with some reaching as high as 16 million people.





More new streets to cater to Cairo's population growing beyond the 16 million mark.

The Nile River is the lifeblood of Egypt as it is the main source of freshwater for household use and irrigation, a source of power from the hydroelectric facility at Aswan, and a means of transportation for people and goods. The only arable regions in Egypt are the green floodplains that line the Nile River.

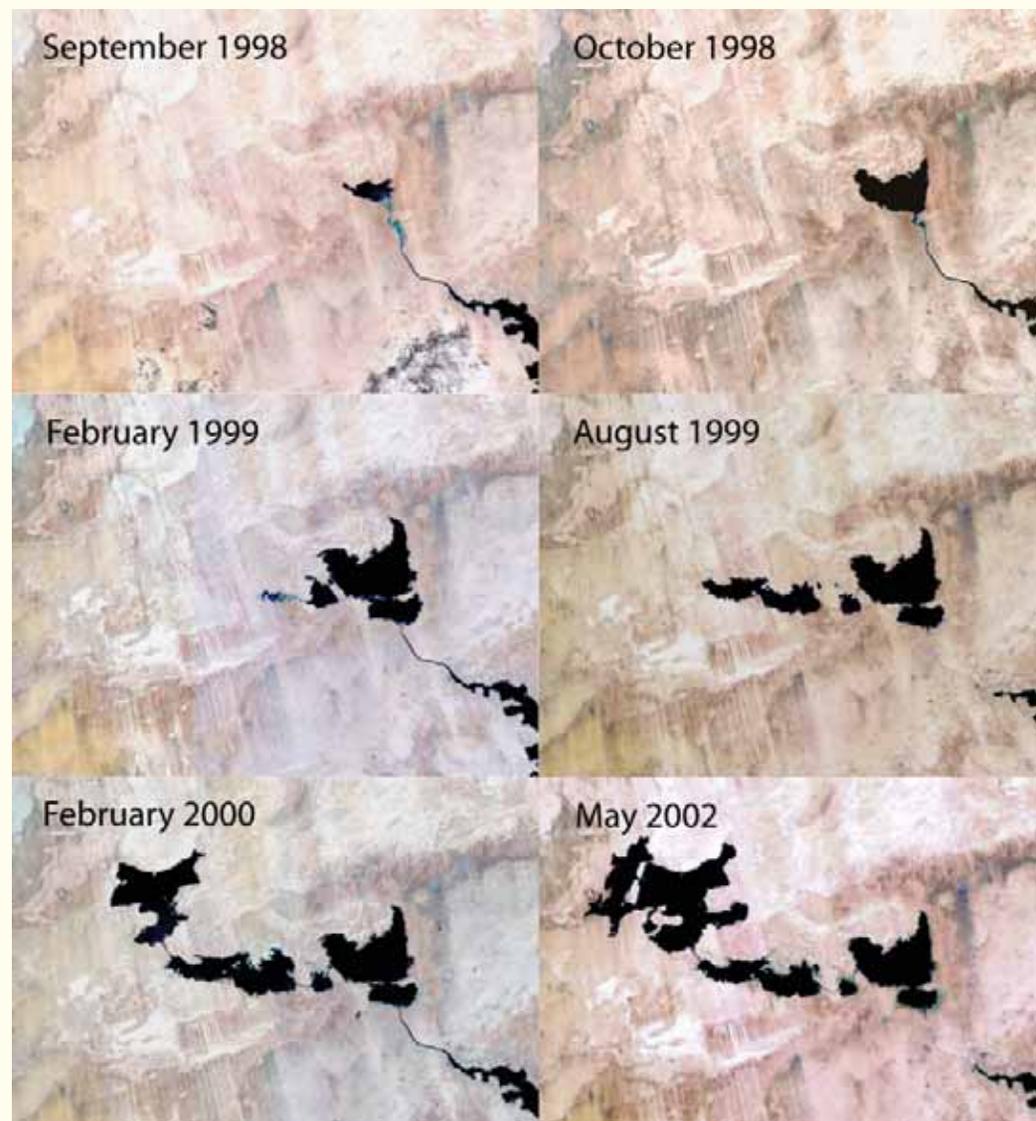
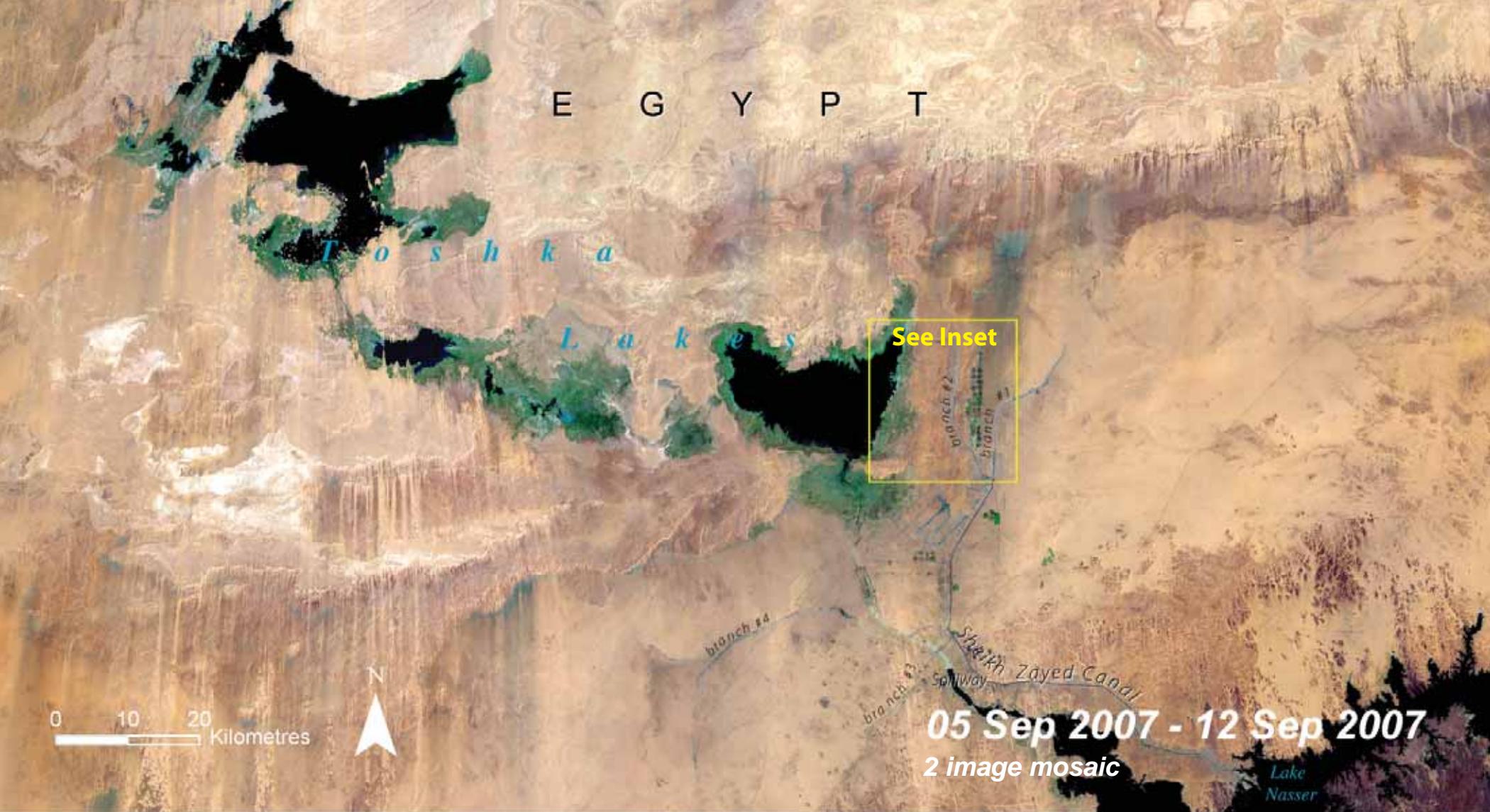
Phenomenal population growth in the 20th century has resulted in the loss of much of the critically needed arable land around Cairo to urban development. The urban extent of Cairo (gray areas) expands dramatically between the 1972 and 2005 images, both into the Arabian Desert to the east and into the lush agricultural areas (green) surrounding the Nile. Most of Cairo's physical growth, particularly its unplanned or informal settlements, has been concentrated on agricultural land.





Nile Waters in the Desert: Toshka Lakes, Egypt

In the mid 1990s, water levels in Lake Nasser on the Nile River approached the reservoir's storage capacity of 183 m above sea level. Excess water was released through a spillway, which flowed into the Toshka Depression in the Western Desert. Over the next several years, continued overflow created a series of lakes on some of Egypt's most arid land. After peaking in 1998, reservoir levels declined and flow through the spillway stopped in 2001. Since that time, water levels in the Toshka Lakes have been declining as well, primarily by evaporation and to a lesser degree by infiltration.



In January 1997, the Egyptian government began construction on a network of canals to continue carrying Lake Nasser water to Toshka with the goal of irrigating 3 360 km² of land in the Western Desert. The project, called the New Valley Project, is intended to relieve overcrowding within the densely populated Nile Valley and provide economic development.

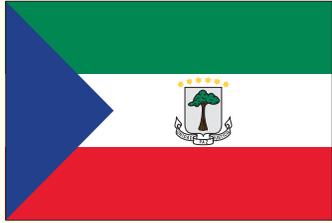
The project is an enormous undertaking with a cost over US\$1 000 million. Critics of the project are concerned that the anticipated withdrawal of 5 000 million m³ of water per year will reduce water available to farmers on the delta, leave Egypt more economically vulnerable to drought, and reduce resources available for other development opportunities. Much of the needed infrastructure is already in place and crops are already being produced on irrigated land including fruits and wheat (green around the lakes, 2007 image).





Republic of Equatorial Guinea

Total Surface Area: 28 051 km²
Estimated Population in 2006: 515 000



Equatorial Guinea is one of the smallest countries in Africa in terms of both area and population. It consists of a small continental territory known as Rio Muni and seven

islands of volcanic origin. The largest island, Bioko, contains the highest population densities in the country and is characterized by mountainous and heavily forested terrain. The climate is tropical and humid, and average annual precipitation levels are among the highest in Africa at over 2 000 mm of rain per year (FAO 2007).

Important Environmental Issues

- Oil Production and Coastal Degradation
- Deforestation
- Bushmeat and Hunting on Bioko Island



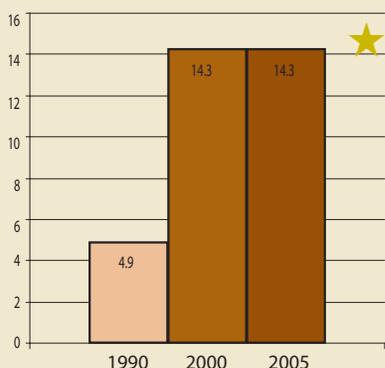
Progress Towards Environmental Sustainability

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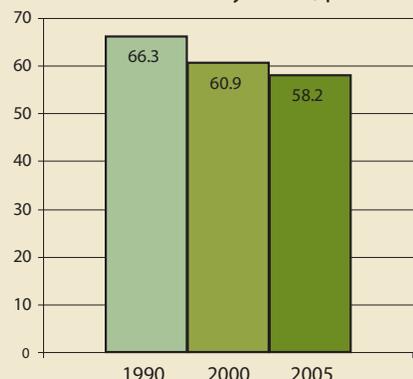
The country's oil production increased from 81 000 barrels per day (bbl/d) in 1998 to more than 300 000 bbl/d by 2004 and an estimated 420 000 bbl/d in 2005. This increase may explain the sharp increase in carbon dioxide emissions. Other problems include deforestation, water pollution, desertification, and wildlife loss. Agriculture is the main economic activity, involving about 71 per cent of the economically active population.

★ Indicates progress

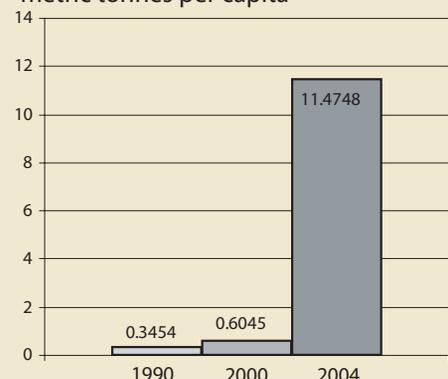
Protected area to total surface area, percentage



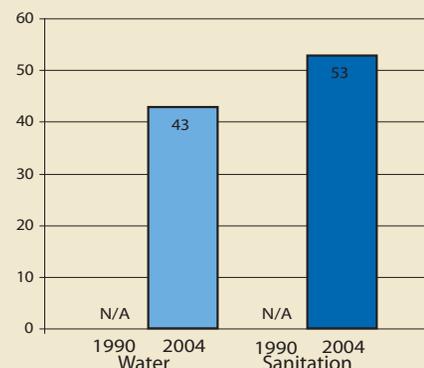
Land area covered by forest, percentage



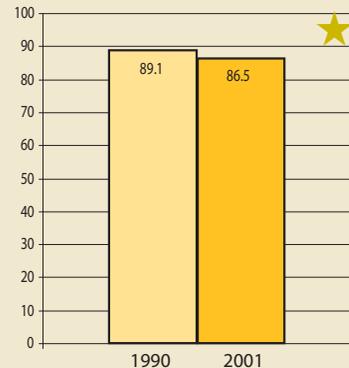
Carbon dioxide (CO₂) emissions, metric tonnes per capita



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban



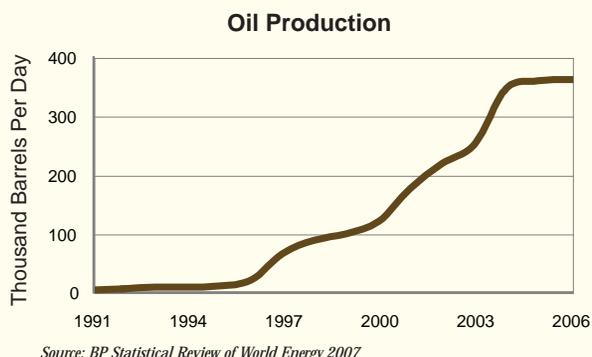
Bioko Island has several endemic sub-species of primates, including the drill (*Mandrillus leucophaeus poensis*) and the red-eared monkey (*Cercopithecus erythrotis*).

Oil Production and Coastal Degradation

Since the early 1990s, oil production has propelled rapid economic growth in Equatorial Guinea, which is now the third-largest oil exporter in sub-Saharan Africa, after Nigeria and Angola (EIA 2007a). In 1999, gross domestic product increased by over 40 per cent, which was the highest growth rate recorded by any country in the world (World Bank 2007).

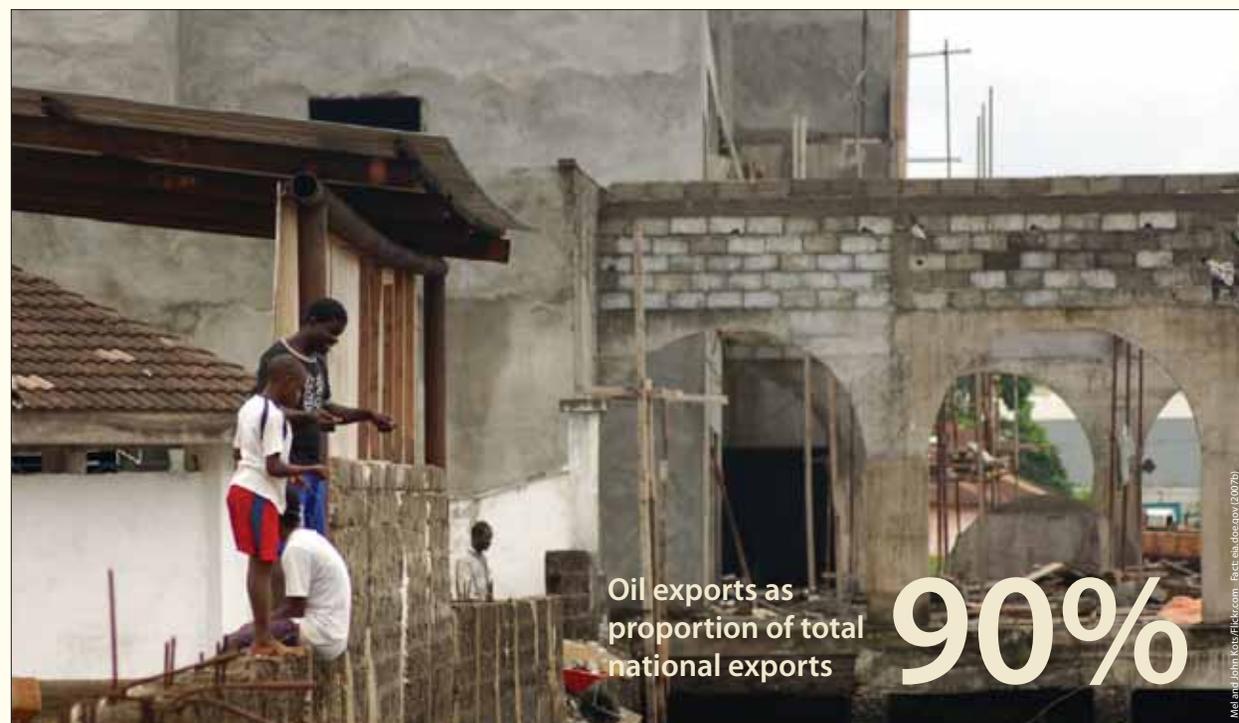
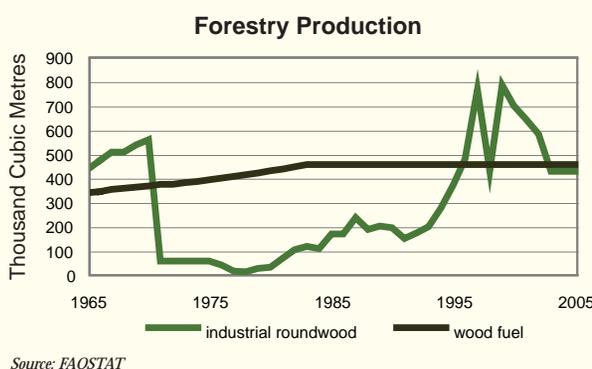
The social and environmental consequences of this economic transformation include rapid urbanisation, increased coastal development, and localized pollution. The urban growth rate is now twice the overall population growth rate (UNESA 2006), thanks to rural-to-urban migration and immigration of foreign oil workers. This has created

a construction boom in the city of Malabo and in other oil towns, resulting in increased coastal degradation and pollution.



Deforestation

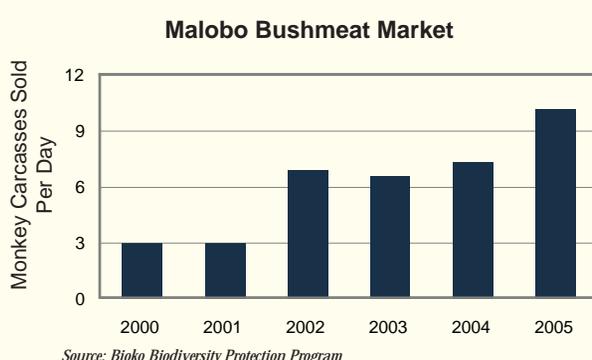
The forestry sector is second only to oil in terms of importance to the national economy in Equatorial Guinea. As of 2005, 58 per cent of the country was forested, which reflects a 12 per cent decrease in forest cover since 1990 (UN 2007). Agriculture and timber harvesting are the major drivers of deforestation, with fuelwood accounting for approximately one-third of all roundwood consumption (FAO 2003). Coastal regions have been hit hardest by this trend, whereas the more inaccessible continental interior and mountainous islands have been spared to some extent.



Bushmeat and Hunting on Bioko Island

Located 51 km off the coast of Cameroon, Bioko Island is a haven for several rare primate species, four of which are subspecies found nowhere else in the world. Its mountainous interior includes the Gran Caldera, a volcanic crater whose high ridges have created a natural wildlife refuge, and Pico Basile, a peak rising over 3 000 m above sea level. In recent decades, the growing commercial bushmeat market in the city of Malabo—encouraged by increased prosperity brought by offshore oil fields—has severely threatened the island's wildlife. Hunters have completely extirpated large forest mammals in the easily accessible lowland areas, and primate populations have been reduced by as much

as 60 per cent since 1986, even in the more isolated wildlife reserves (BIOKO 2006).



Punta Europa

Gulf of Guinea

EQUATORIAL GUINEA
Bioko Island

12 Nov 2000



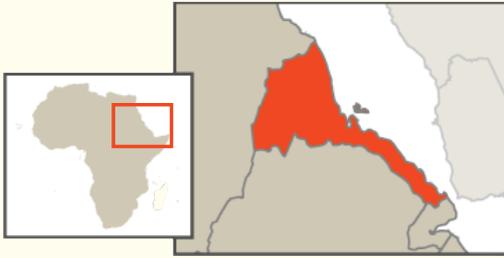
Oil and Gas: Punta Europa, Equatorial Guinea

Petroleum and natural gas are key to Equatorial Guinea's rapid development and growing GDP. The Alba gas field located 19 km north of Bioko Island is the country's largest natural gas field, with 37 000 million m³ of proven reserves. The above images show massive infrastructural development of the gas and the hydrocarbon facility at Punta Europa on Bioko, between 2000 and 2007.



The Punta Europa plant flares natural gas and associated byproducts—initially at a rate of approximately 2.5 million m³ per day to the current volume of about 3.5 million m³. To reduce the economic and environmental damage associated with this flaring, the Atlantic Methanol Production Company completed construction of a methanol plant at Punta Europa in May 2001. The plant consumes around 3.5 million m³ per day of quality gas to produce 19 000 barrels per day of methanol used in a variety of industries. Similarly, Marathon Oil and its partners are nearing completion of a liquefied natural gas plant at Punta Europa. These two facilities will eliminate the need to flare gas at Punta Europa. The projected greenhouse gas reduction from the methanol plant alone is 2.85 million metric tonnes of carbon dioxide equivalent per year for each year of the project.





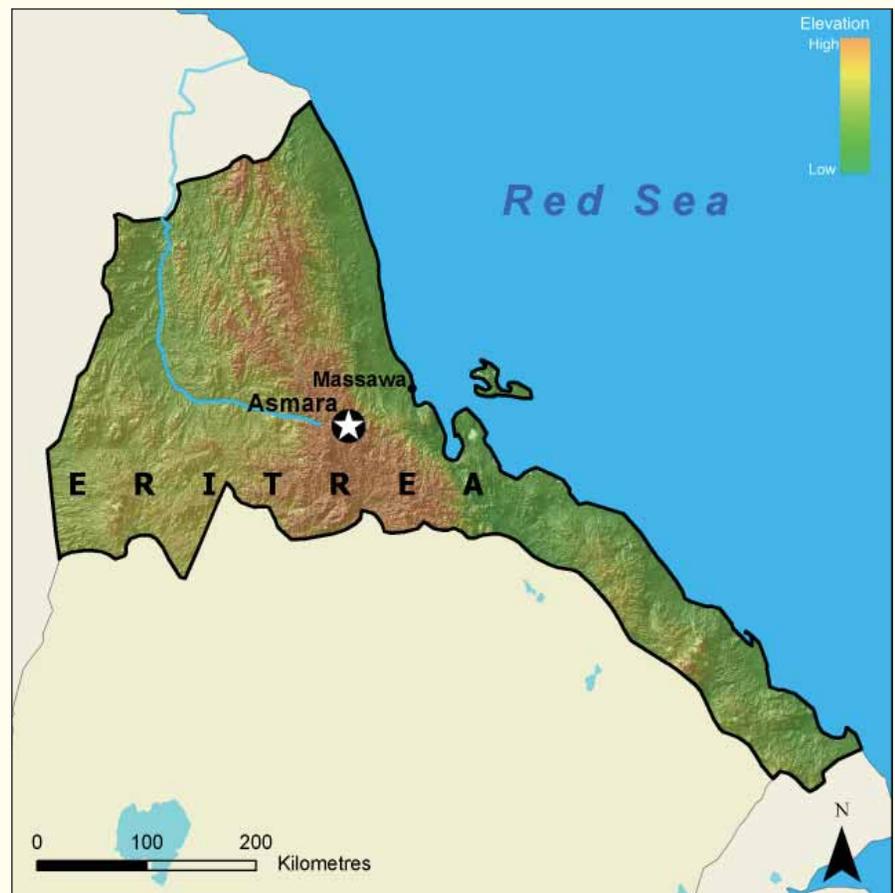
Eritrea

Total Surface Area: 117 600 km²
Estimated Population in 2006: 4 560 000



Eritrea consists of diverse climates and landscapes, from a hot and dry Red Sea coastal plain to temperate central highlands. Dividing

the country between semi-arid lowlands to the east and west, the highlands range between 1 500 and 2 000 m in altitude and are among the oldest areas cultivated by humans in the world. Sixty-five per cent of the population lives in the highlands, although the highlands account for only 19 per cent of the total land surface (FAO 2005a).



Important Environmental Issues

- Water Stress
- Land Availability and Land Degradation
- Deforestation and Threats to Biodiversity

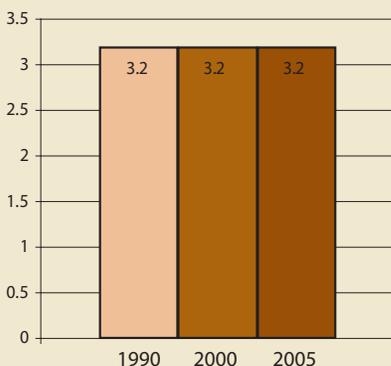
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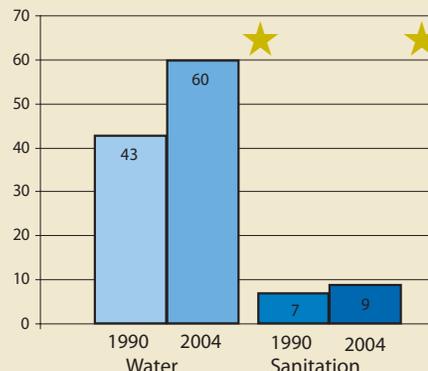
Eritrea has 391 000 hectares of arable land and 2 000 hectares under permanent cultivation. Three-quarters of Eritrea's people are subsistence farmers dependent on unreliable rainfall to feed families that average seven children. Eritrea's forested area covers 1 585 000 hectares of the total land area. When Eritrea became independent from Ethiopia, it gained about 1 011 km of Red Sea coast.

★ Indicates progress

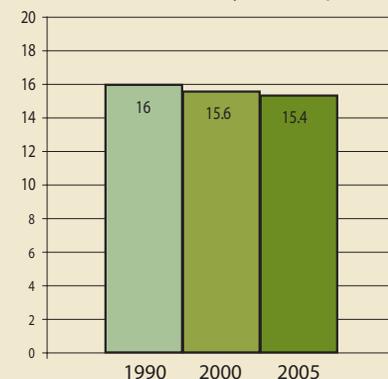
Protected area to total surface area, percentage



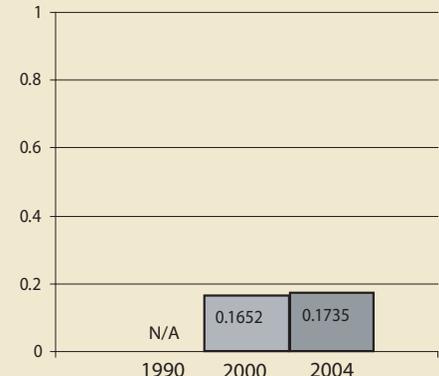
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



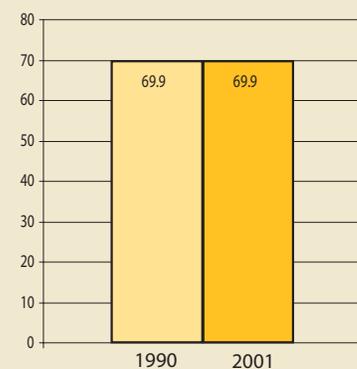
Land area covered by forest, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



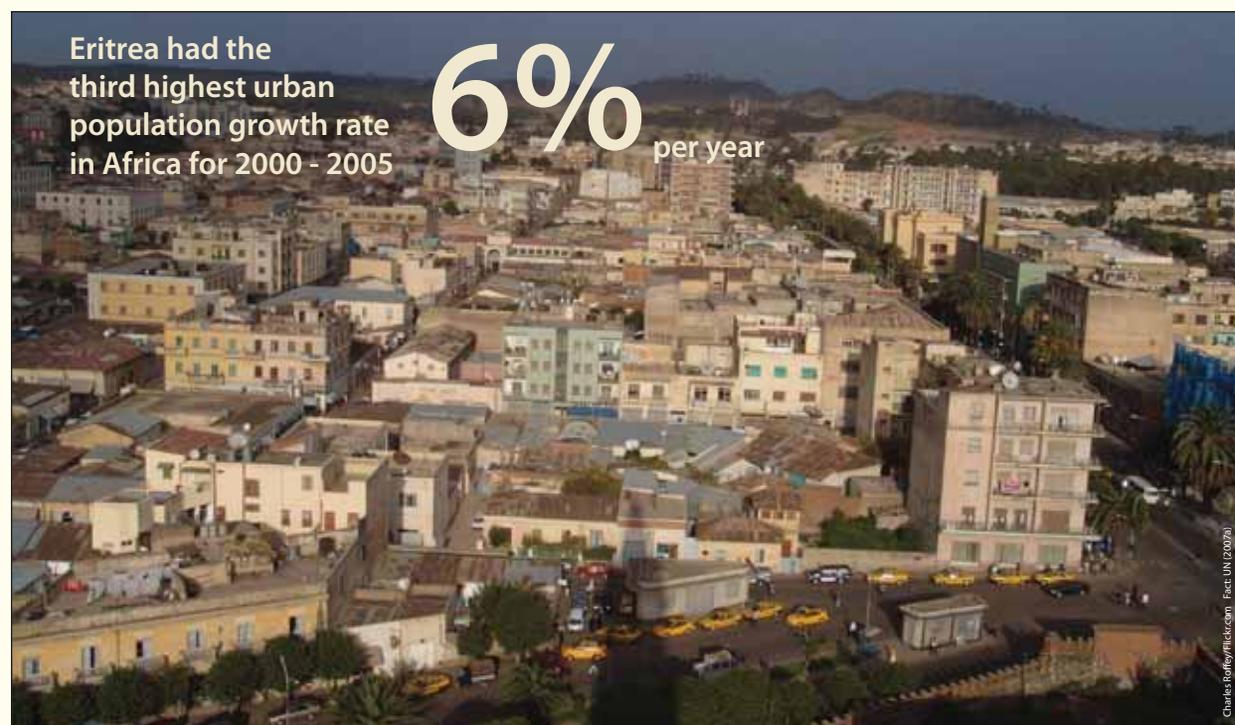
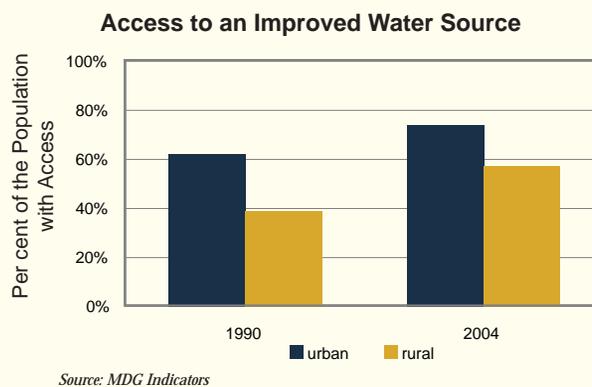
Slum population as percentage of urban



In 2006, Eritrea announced it would become the first country in the world to turn its entire coastline into an environmentally protected zone.

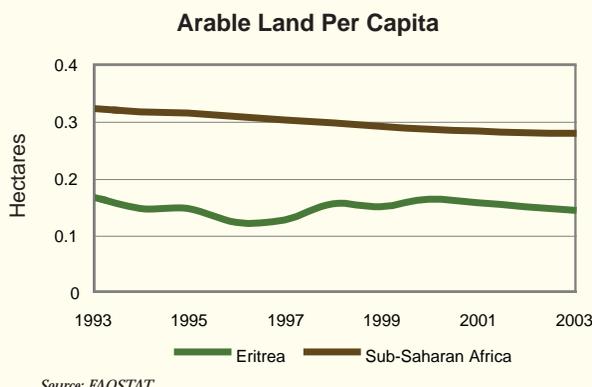
Water Stress

With only one perennial river and no natural fresh surface water bodies, Eritrea depends on groundwater resources that are regionally limited in both quantity and quality. The country is below the international threshold for water stress with only 1 338 m³ available per person per year (Earth Trends 2007 and UNESA 2005). Agriculture accounts for 95 per cent of all water withdrawals (FAO 2005b), although only four per cent of cropland is irrigated. It is estimated that demand for water is ten times greater than the national supply, indicating a 3 500 million cubic metre water gap (UNDP 2006).



Land Availability and Land Degradation

Eritrea is at extremely high risk of desertification due to its arid climate and heavy reliance upon agriculture despite limited availability of arable land. Only 6.3 per cent of land is suitable for cultivation and most of this potential has already been exploited (UNEP 2006). But continued population growth has forced expansion onto marginal lands and steep slopes. Livestock grazing, which is concentrated predominantly in the semi-arid western lowlands, has also exposed soils to water and wind erosion. Overall, 63 per cent of land is considered to be severely degraded (FAO AGL 2003).

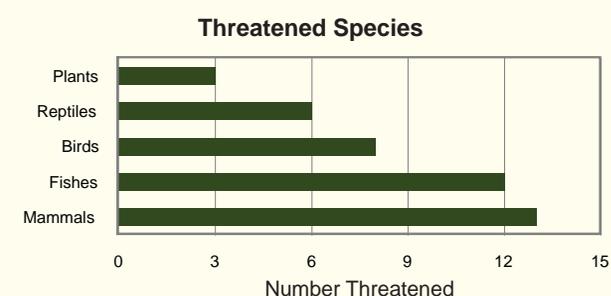


Deforestation and Threats to Biodiversity

Forests account for only 15 per cent of land in Eritrea (UN 2007b), although original forest cover is estimated to have been twice that amount (FAO 2001). Deforestation is driven by agricultural expansion, deliberately set forest fires, and demand for fuelwood. Deforested terrain is particularly

vulnerable to soil erosion due to torrential and erratic rainfall. Furthermore, deforestation removes valuable habitat for threatened species, including elephant, wild ass, greater kudu, and civet, all of which are in danger of national extirpation.

Unlike Eritrea's interior, its long coast is sparsely inhabited, resulting in a relatively pristine coastal and marine environment. The Red Sea coast and the 350 islands of the Dahlak Archipelago support fertile fishing grounds, with over 1 000 species of fish, 220 species of corals (FAO n.d.), and 851 km² of mangrove forest (Spalding and others n.d.). In 2006, Eritrea announced its intention to become the first country in the world to turn its entire coast into a marine protected area.



E R I T R E A



● Hagigo



0 0.25 0.5 Kilometres



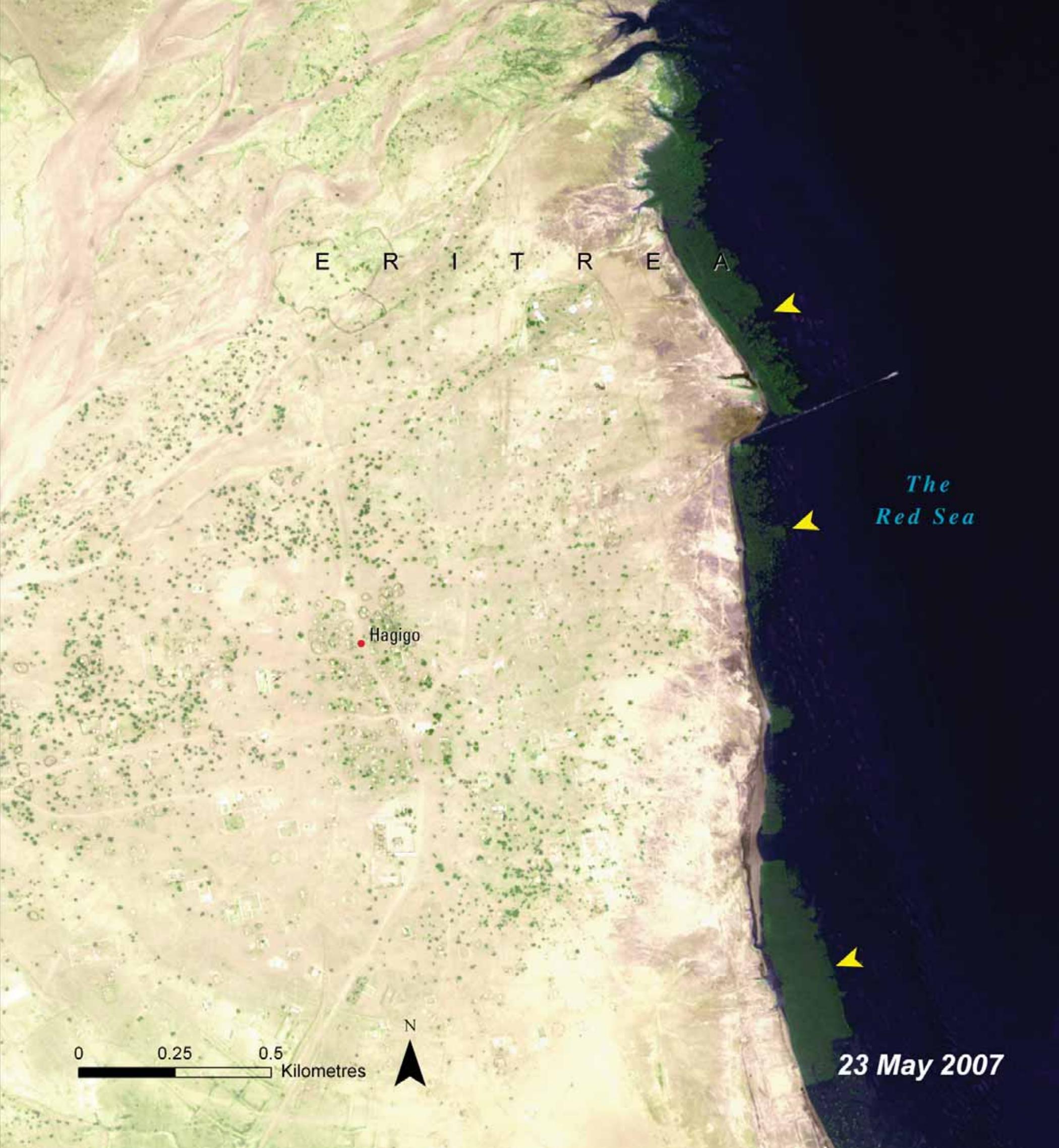
The Red Sea

15 Dec 2001



Cultivating Mangroves: Hagigo, Eritrea

Along 15 per cent of Eritrea's coast there are stretches of green that contrast with the arid environment surrounding them. They are mangroves—stands of salt tolerant trees and plants that can get their water from the sea. Dr. Gordon Sato, a retired molecular biologist, wondered why they occur only intermittently rather than along the entire coast. He discovered that streams flowing into the Red Sea during seasonal rains provide nutrients that the mangroves need to grow. He devised a simple means of delivering these missing nutrients, allowing mangroves to be grown on otherwise barren shoreline.



More than 700 000 mangrove seedlings have been planted along the Eritrean coast since 2001, (yellow arrows). These mangroves flourish with low cost applications of fertilizer. The 2001 and 2007 images of the coast near Hagigo, Eritrea, show how quickly the seedlings are growing into stands of mangrove trees (yellow arrows). The mangrove's leaves provide fodder for sheep, which in turn are a source of food for the Eritrean population.

The so-called Manzanar Project aims to develop self-sufficiency in Eritrea, village by village. Coupled with aquaculture, the mangroves provide both a land- and sea- based economy that might eventually be developed for the specialty seafood export market.





Federal Democratic Republic of Ethiopia

Total Surface Area: 1 104 300 km²
Estimated Population in 2006: 79 289 000



Credit: Flagant.com

Ethiopia is the tenth-largest and second most populous country in Africa. Most of the population occupies the plateau and

central mountain range of the rugged Ethiopian Highlands, which are divided diagonally by the Great Rift Valley and surrounded to the east and west by lowland deserts. The highlands, which account for roughly half of the country's area (Woldeyes n.d.), are also the source of the Blue Nile, which originates in Lake Tana in the northwest and contributes two-thirds of the Nile River's water.

Important Environmental Issues

- Water Availability and Access to a Safe Source
- Livestock, Soil Erosion, and Land Degradation
- Threats to Biodiversity and Endemism



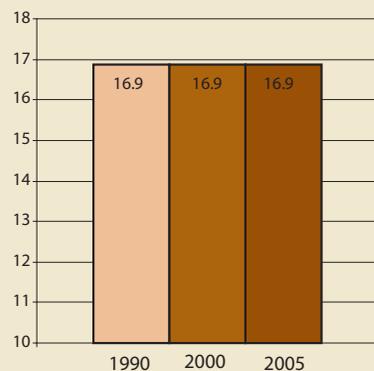
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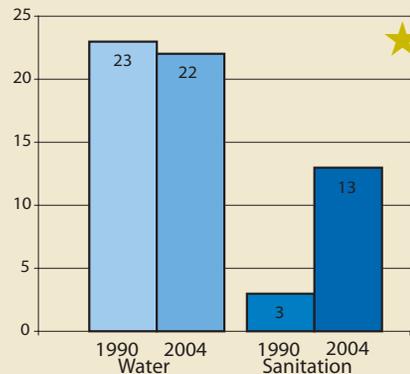
Availability of clean water and sanitation in Ethiopia is among the lowest in the world and, in the case of water, the situation is deteriorating. An estimated three-quarters of children's health problems and communicable diseases have an environmental cause. Ethiopia's land area under protection remains fairly constant. Nearly 70 per cent is arable yet only 11 per cent is under cultivation with permanent crops; almost 12 per cent is forested.

★ Indicates progress

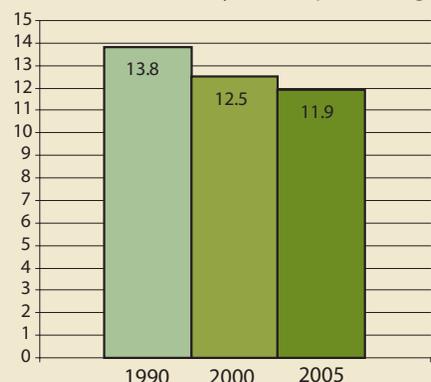
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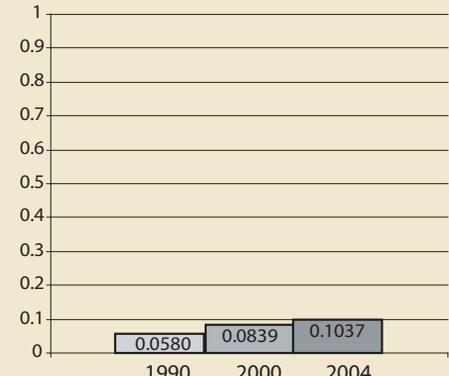
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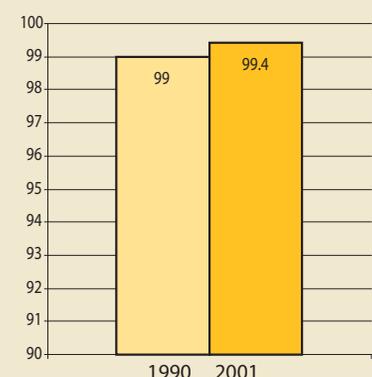
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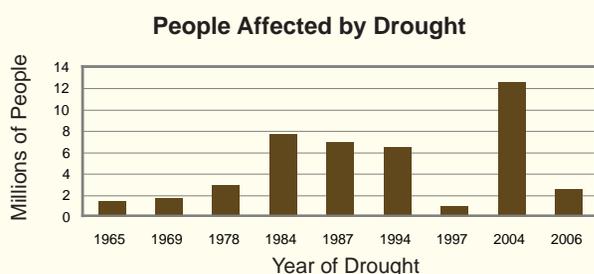
In 2005 scientists watched a 60 kilometre fissure develop in the Afar Desert of Ethiopia. The fissure created an eight metre wide rift at its centre which may be the beginning of a "future ocean."

Water Availability and Access to a Safe Source

Although surface water resources are relatively abundant, they are largely undeveloped and unevenly distributed. Approximately 70 per cent of runoff is obtained between June and August (FAO 2005), and recurring droughts and erratic

rainfall are frequently responsible for widespread food insecurity and significant loss of livestock and crops. During a severe drought in 2003, for example, over ten million people required food aid and the gross domestic product declined by 3.3 per cent (CIA 2007).

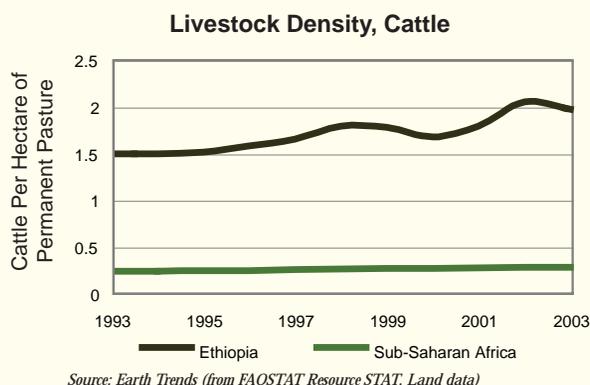
As a consequence of both natural and economic circumstances, only 22 per cent of the population has access to an improved water source, the lowest proportion in Africa (UN 2007). The situation is acute in both rural areas, where 84 per cent of the population resides (UNESA 2006), and in urban areas, where over 99 per cent of inhabitants are slum-dwellers (UN 2007).



Source: EM-DAT disaster database

Livestock, Soil Erosion, and Land Degradation

Desertification and soil erosion are widespread in Ethiopia, particularly in the highlands where the terrain is very steep, and where the majority of agricultural production occurs. Ethiopia has the seventh-largest cattle stock in the world (FAO 2007), and overgrazing coupled with heavy dependence on dung for fuel is a significant driver of land degradation. Other factors include deforestation and poor farming practices. Overall, 85 per cent of the land is classified as moderately to very severely degraded (FAO AGL 2003) and 70 per cent is affected by desertification (UNCCD 2002).



Source: Earth Trends (from FAOSTAT Resource STAT, Land data)



Ethiopia has the lowest access to an improved water source in Africa at

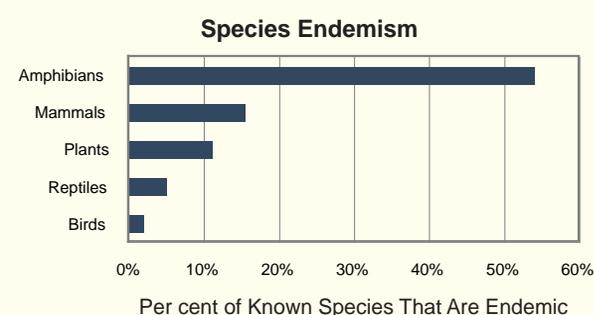
22%

Charles Fred/Flickr.com Fact: mdgsun.org (2009)

Threats to Biodiversity and Endemism

Wide variation in climate and topography contribute to Ethiopia's rich biological resources—of approximately 7 900 identified plant and animal

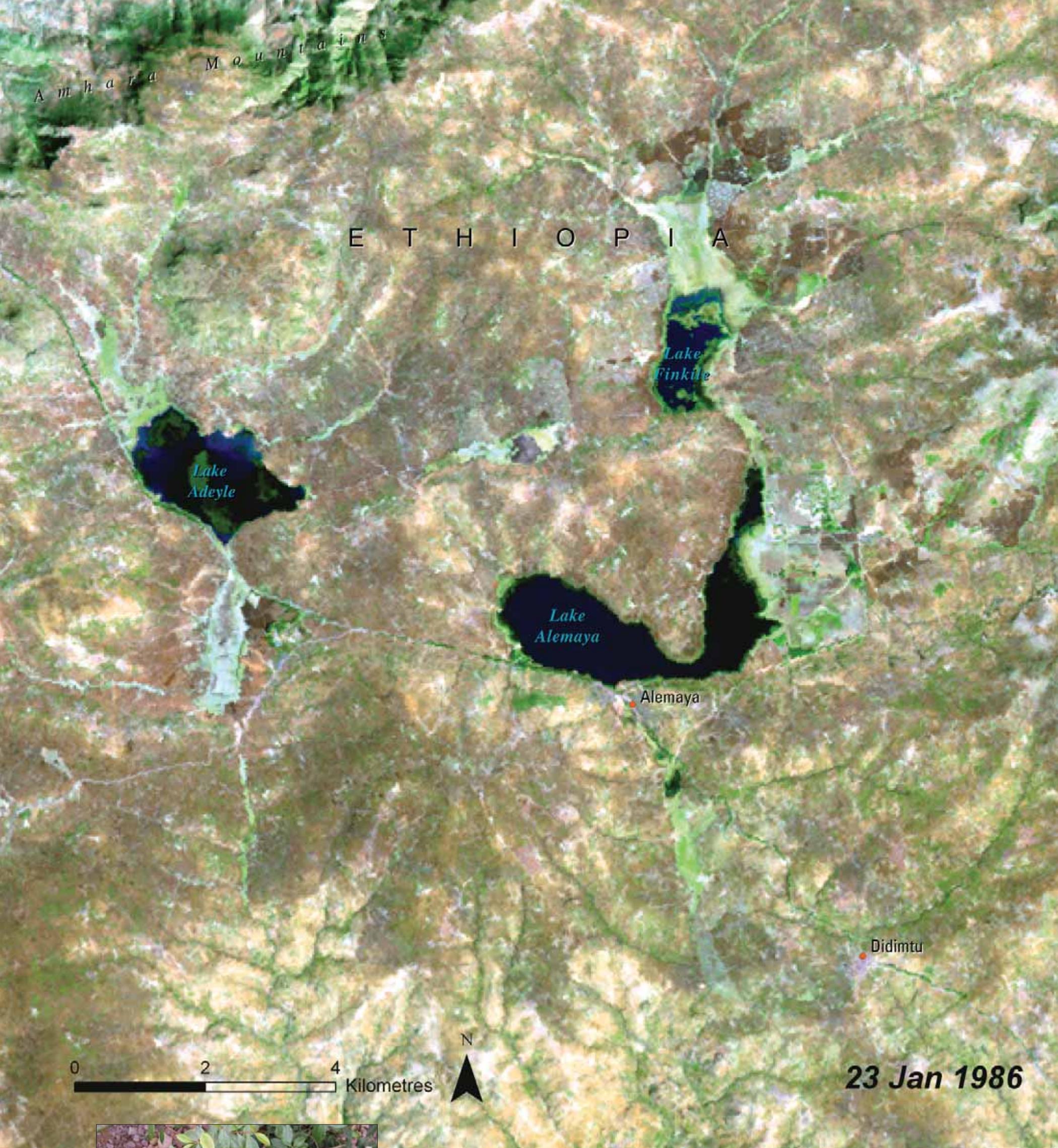
species, over ten per cent are endemic. Threats to biodiversity include overexploitation, conversion of habitats for agriculture, and deforestation. It is estimated that forest cover now constitutes less than four per cent of the original forest extent (CBD 2005).



Source: Earth Trends (from Ethiopia's Third National Report to the CBD)

Ethiopia's Simien National Park was one of the first sites added to the UNESCO World Heritage list in 1978. Located in the north, the park contains spectacular landscapes of jagged mountain peaks and deep valleys, and it provides refuge for rare species such as the Simien fox and Walia ibex, a goat that is found only in this area.





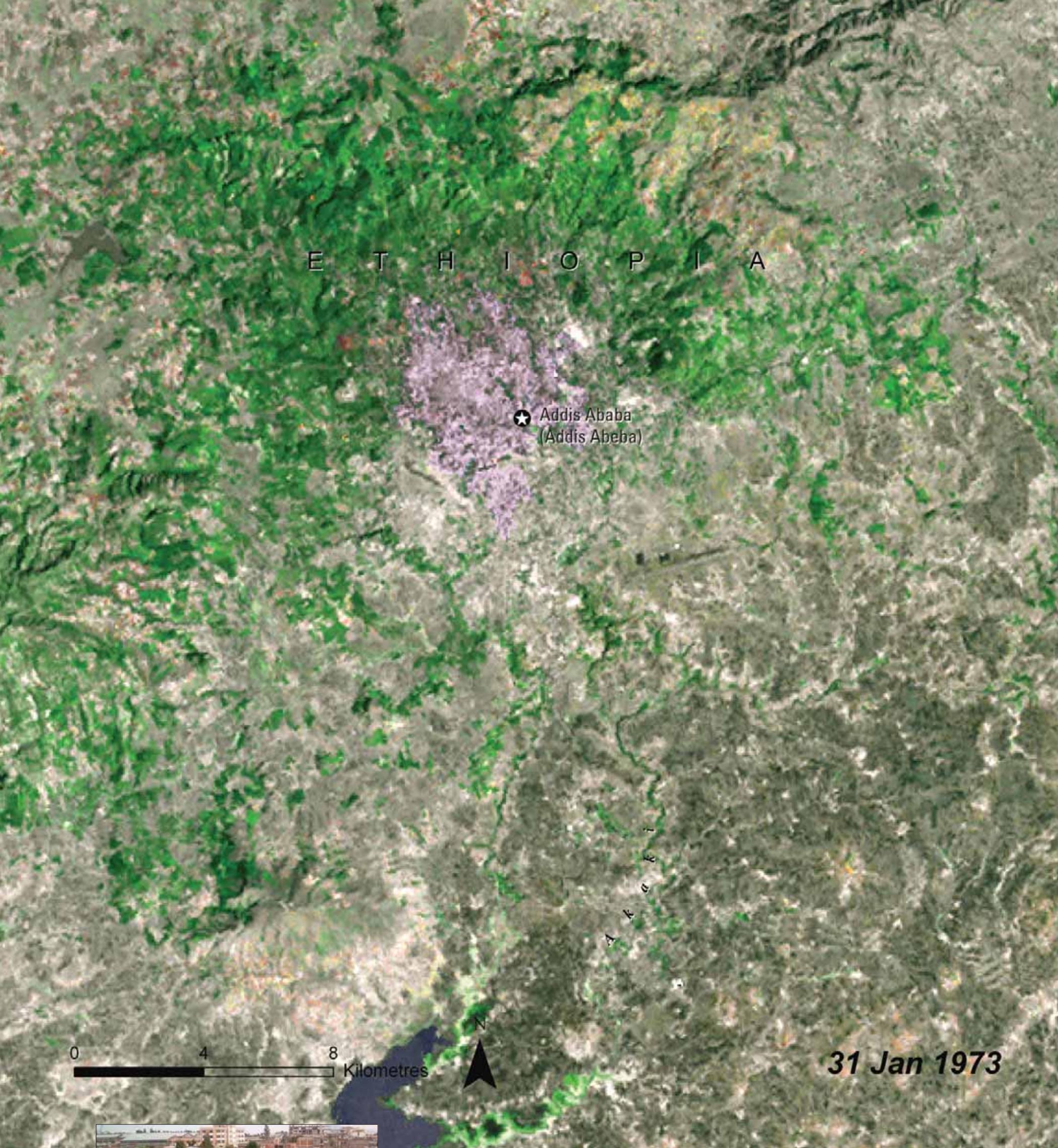
Shrinking Water Resources: Lake Alemaya, Ethiopia

Lake Alemaya in the Ethiopian Highlands has historically provided the surrounding area with water for domestic use, irrigation, and livestock and has served as a local fishery. As recently as the mid-1980s its maximum depth was around eight metres and it covered 4.72 km². Since then Alemaya's water level and surface area have declined considerably, as is evident in these images. In recent years, low water levels have interrupted the water supply in Harar, a nearby town of over 100 000.



Increasing irrigation and domestic water use, change in the local climate, and changes in the surrounding land cover are believed to be the causes of Alemaya's demise. Agriculture expanded dramatically starting in the mid-1970s due to improved infrastructure, increased population, and changes in government policies toward production and marketing. Among the crops grown is khat, a psychoactive leaf consumed heavily in northeastern Africa. Khat has become an exported cash crop in recent decades and irrigation has increased as a result. In addition, siltation caused by the deforestation of the Alemaya watershed has reduced the capacity of the shallow lake. A trend of warmer temperatures since the mid-1980s may also have increased the rate of evaporation from the lake.

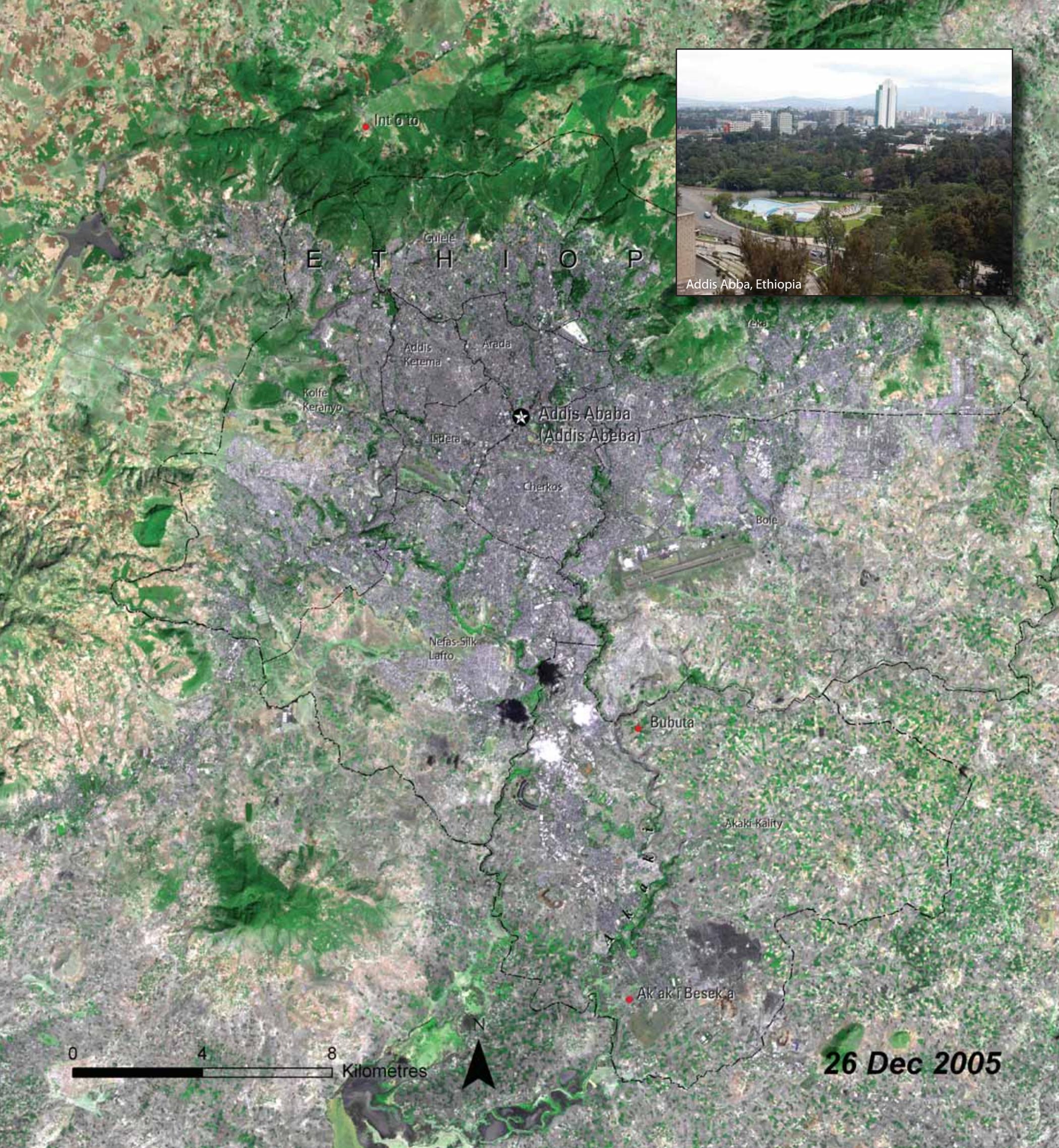




Urban Sprawl in Addis Ababa: Ethiopia

Addis Ababa, the capital of Ethiopia, was established in 1889. Major urban migration into the city began in the mid-1970s, driven mainly by unemployment, poverty, and declining agricultural productivity in rural areas. The population of Addis Ababa is currently 2.9 million, and is projected to grow to 5.1 million by 2015.

Ethiopia as a whole has an annual population growth of 2.8 per cent. Twenty-seven per cent of Ethiopia's urban population lives in Addis Ababa and this has created substantial pressure



on the city's infrastructure, housing, and urban services. These satellite images taken in 1973 and 2005 show the development of Addis Ababa's massive urban sprawl.

In 1996, the city had only 238 000 residential housing units. That same year, the total number of households was estimated to be 460 000, leaving 220 000 households or nearly 1 000 000 residents without suitable housing. This situation led to illegal housing construction and uncontrolled settlements, some of which are encroaching on protected forest and reserve lands at the edges of the city.

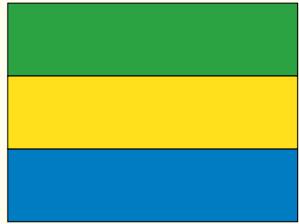




Gabonese Republic

Total Surface Area: 267 668 km²

Estimated Population in 2006: 1 406 000



Gabonese Republic, or Gabon, is one of the least densely populated countries in Africa with less than two inhabitants per square kilometre (Earth Trends 2006 and FAO 2005). A narrow coastal plain

characterized by many lagoons and estuaries runs along the country's 800 kilometre-long Atlantic coast, giving rise to a hilly, forested interior and savannah plains to the east and south. The climate is generally hot and humid all year round, with two rainy seasons and two dry seasons.

Important Environmental Issues

- Threats to Biodiversity
- Coastal Degradation and Industrial Pollution
- Lack of Sanitation and the Urban Environment



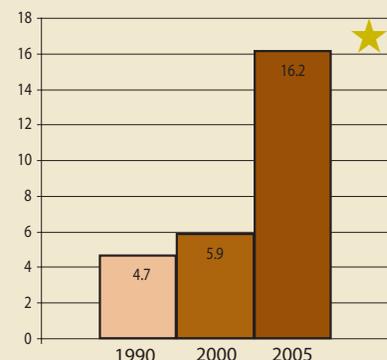
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

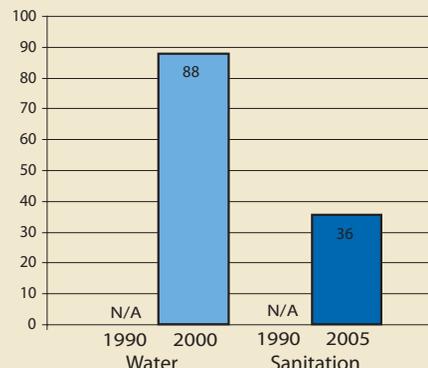
Gabon's growing urban centres and slum population increases industrial and domestic contaminants, thus polluting the nation's water supply. Gabon is one of the few places where primary tropical rain forest still extends all the way to the beach. Even though Gabon's coastal forests are slowly being depleted, a reforestation program has been successful in retaining most of the interior dense forest cover and in increasing the percentage of protected areas.

★ Indicates progress

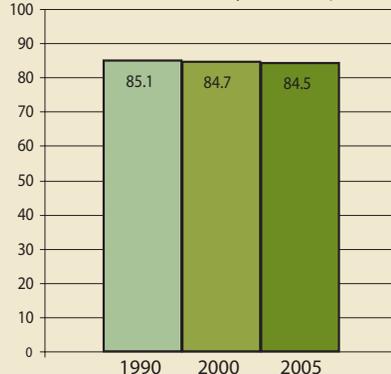
Protected area to total surface area, percentage



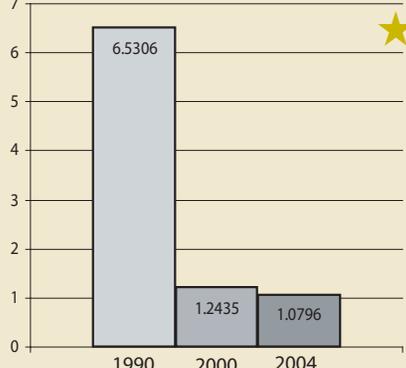
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



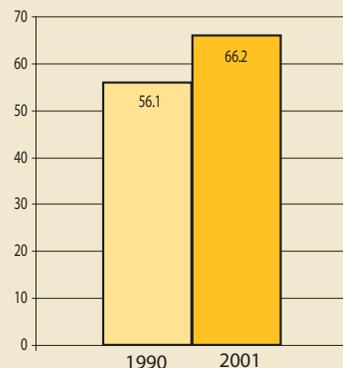
Land area covered by forest, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



Slum population as percentage of urban



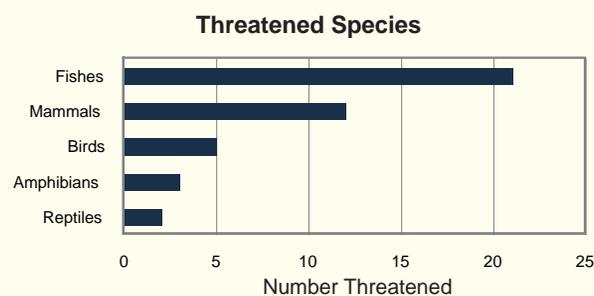
Gabon has more than 8 000 species of plants, 20 per cent of which are endemic.

Threats to Biodiversity

Forests cover 85 per cent of Gabon's surface area, which is the highest proportion of any mainland African country (UN 2007). These forests are home to approximately 8 000 plant species, of which 20 per cent are endemic (CBD 2007). Although total forest cover has remained stable over recent decades due to the declining rural population, selective logging for valuable tree species is a growing threat to forest biodiversity—nearly half of Gabon's forests were affected as of 1998 (CBD 1999).

Gabon's forests also shelter several endangered mammal species, including chimpanzees, gorillas, and elephants. The commercial bushmeat trade, driven by both domestic and international markets,

is a growing threat to wildlife populations. Hunting as well as recent outbreaks of the deadly Ebola virus are estimated to have reduced the great ape population by over 50 per cent between 1983 and 2002 (Walsh and Others 2003).



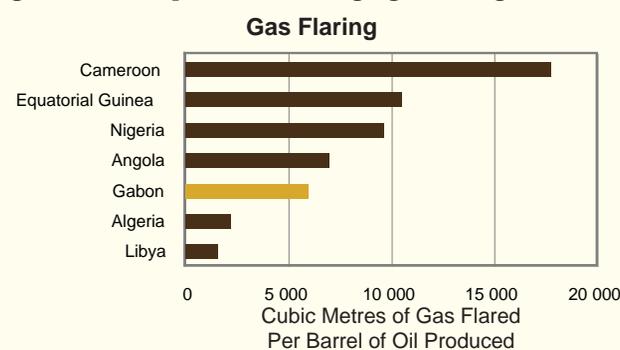
Source: IUCN Red List

Coastal Degradation and Industrial Pollution

Nearly two-thirds of Gabon's approximately 1.5 million inhabitants live within 100 km of the coast (CIESIN 2000), resulting in significant localised environmental degradation. Clearing of mangrove forests, for example, has led to intense coastal erosion, which is particularly troubling in light of climate change and potential sea-level rise (UNEP 2002).

Pollution from industrial sectors, including timber and oil, has also degraded the coastal environment. Oil production, which is the principal economic activity in the country accounting for nearly one-half of gross domestic product (CIA

2007), has contaminated coastal waters and generated air pollution through gas flaring.

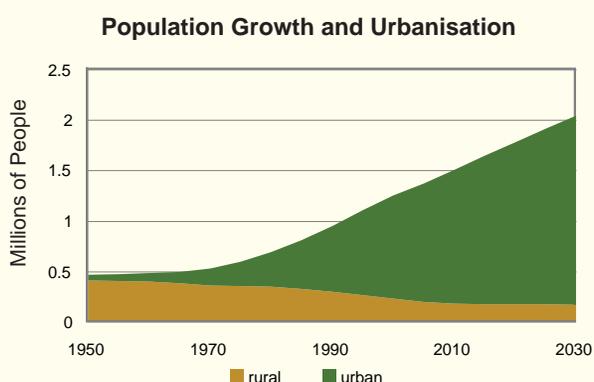


Source: Earth Trends (from World Bank and BP Statistical Review of the World Energy 2007)

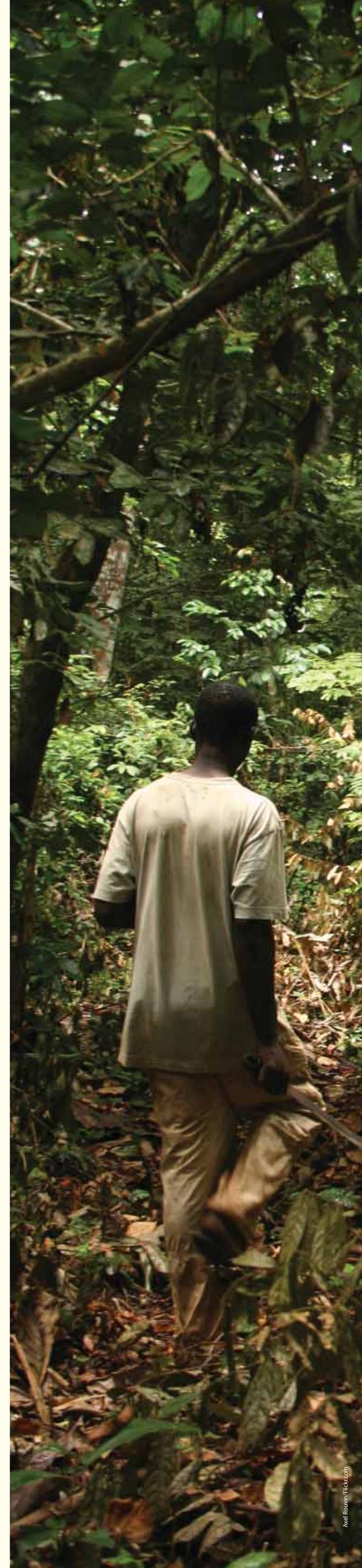


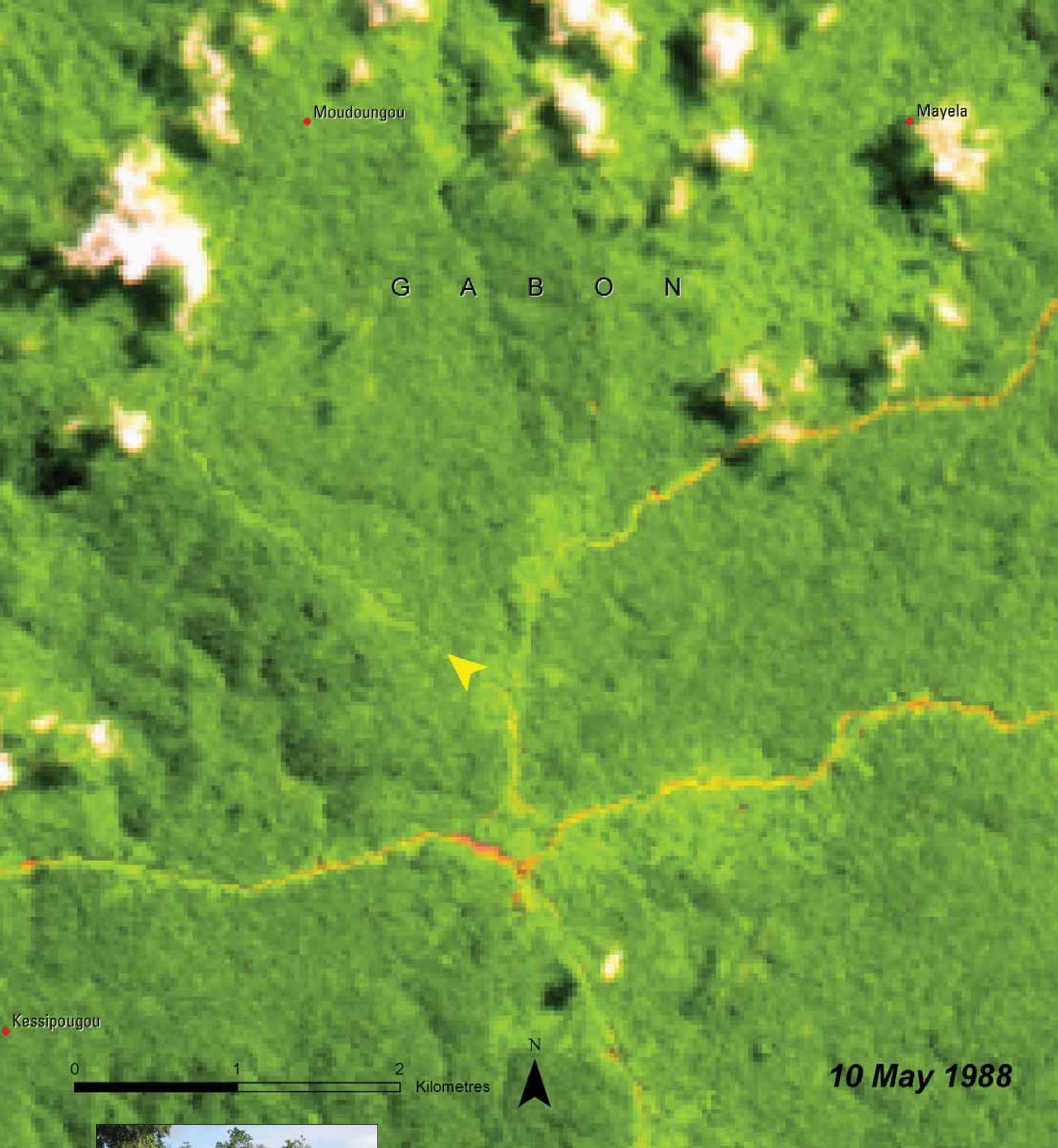
Lack of Sanitation and the Urban Environment

Roughly 84 per cent of Gabon's population resides in urban areas, especially in the capital city of Libreville. The urban population continues to grow by 2.4 per cent per year while the rural population declines by 1.6 per cent per year (UNESA 2006), resulting in a proliferation of urban slums and inadequate housing (approximately two-thirds of city residents are slum-dwellers (CBD 2007). Municipal pollution is on the rise as a result of improper household waste disposal, affecting nearby rivers, streams, and marine ecosystems and taking a toll on human health. Only 37 per cent of urban residents have access to an adequate sanitation facility (CBD 2007).



Source: UN Population Division, World Urbanization Prospects

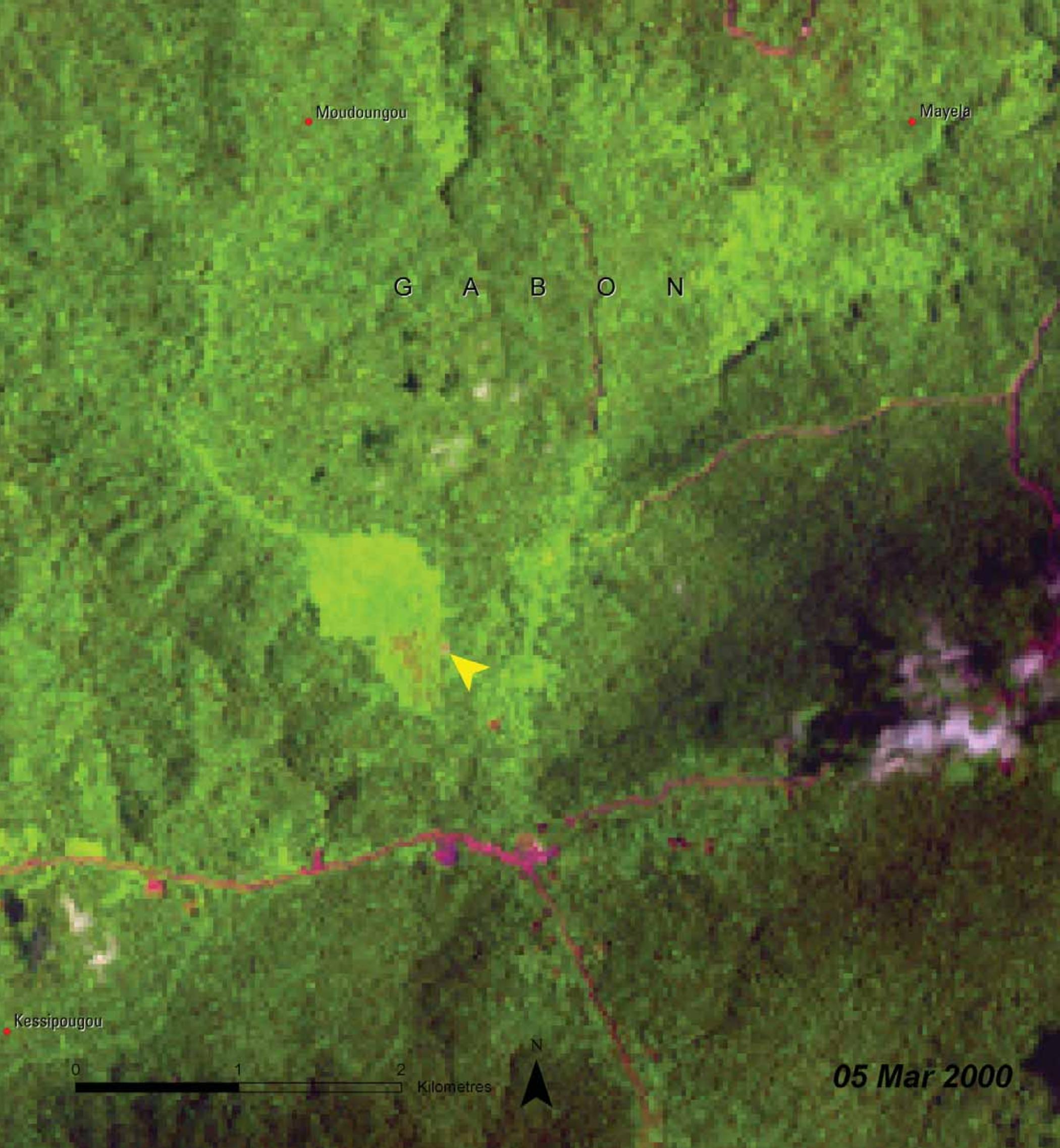




Forestry in the Guineo-Congolese Forest: Gabon

Various sources estimate Gabon's forest cover at between 17 and 20 million hectares, comprising the majority of the Guineo-Congolese forest. Guineo-Congolese forest is a tropical rain forest ecosystem known for its high species richness and endemism. This forest is an invaluable resource to Gabon locally and is also important globally as a source of biodiversity and a carbon sink, which influences the global climate.

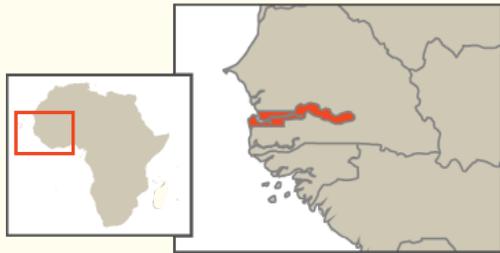
Over the past 40 years, the area of forest allocated to logging concessions has grown from less than 10 per cent to over 50 per cent with most of this increase occurring in the last decade.



Okoume, a valuable African hardwood, accounts for over 70 per cent of Gabon's timber harvest. It is selectively harvested by clear-cutting patches of Okoume, leaving a few trees to encourage regrowth. During the first six months of 2005, production of logs of all species in Gabon rose 4.7 per cent over the previous year

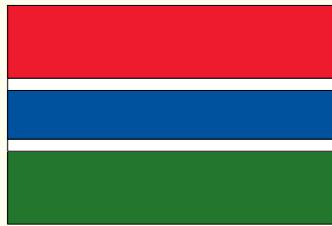
The 2000 image shows a clear cut patch in the centre of the image at a regrowth stage. This is in contrast to the 1988 image, in which only slight disturbance of the forest cover is visible (yellow arrow). The least densely populated country in Central Africa, Gabon has less pressure than many of its neighbours to convert forests to agricultural land. With good forest management practices, the immense value of Gabon's Guineo-Congolese forest can be sustainably utilized for many generations.





Republic of the Gambia

Total Surface Area: 11 295 km²
Estimated Population in 2006: 1 556 000



The Gambia is the smallest and third most densely populated country on the African continent. It extends roughly 300 km east from the Atlantic Ocean along the banks of the River Gambia, which divides the country into two narrow strips of land each, no more than 25 to 50 km wide. The landscape is dominated by two major topographical units, the lowland river floodplains and the upland plateaus.

Climate is characterized by one rainy season followed by a long dry season between November and May.

Important Environmental Issues

- Drought and Agricultural Productivity
- Threats to Forest and Wetland Ecosystems
- Overfishing and Coastal Erosion



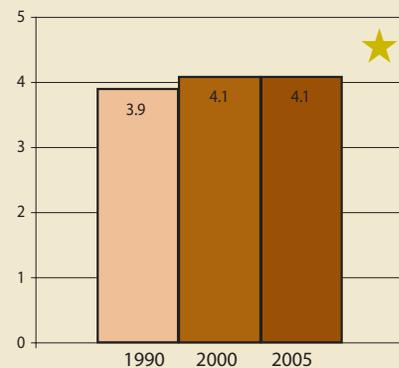
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

Only nine per cent of the Gambia's existing forests survived the expansion of agricultural land and the use of trees for fuel. With 30 per cent decrease in rainfall over the last 30 years, the desertification rate for agricultural lands has accelerated. According to the United Nation's Food and Agriculture Organization, in the past five years the Gambia has seen a net increase in forest cover, likely resulting from increased plantations.

★ Indicates progress

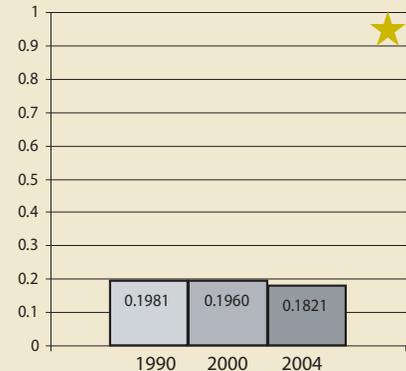
Protected area to total surface area, percentage



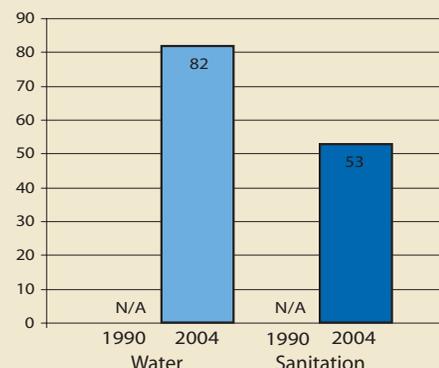
Land area covered by forest, percentage



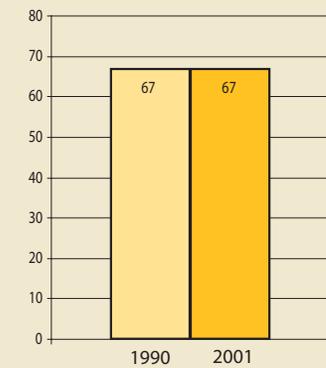
Carbon dioxide (CO₂) emissions, metric tonnes per capita



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

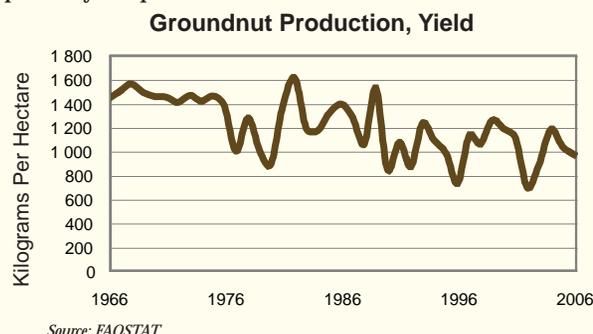


The Gambia is the smallest of the mainland African states.

Drought and Agricultural Productivity

In 2003, agriculture employed nearly 80 per cent of the Gambia's labour force and contributed nearly one-third to its gross domestic product (FAO 2005), despite generally poor soil quality in the country. Most farmers are poor, cultivate small areas of land, and use minimal inputs of fertilizer and pesticides. Decreasing average rainfall over the past three decades (CIA 2007), has created challenges for agriculture and increased saltwater intrusion. During the dry season, saltwater can be detected up to 250 km inland from the coast (FAO 1997), contaminating soil and freshwater wells. The consequences of drought, including soil erosion

and degradation, have been particularly acute in the upland areas where groundnuts are the primary crop.

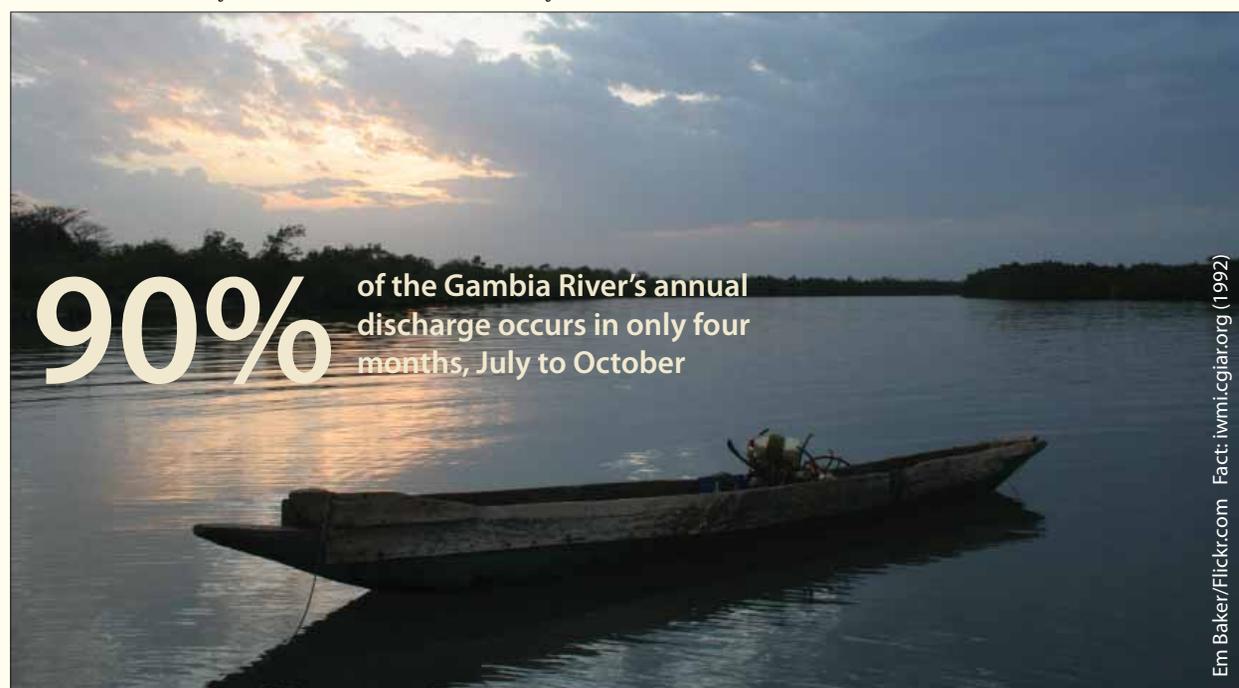
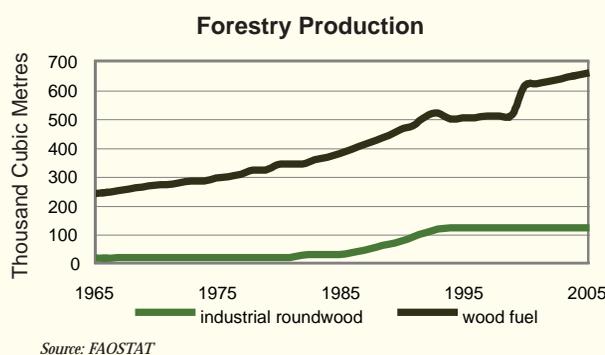


Threats to Forest and Wetland Ecosystems

The Gambia is heavily forested compared to other Sahelian countries, with forests accounting for 42 per cent of land cover (UN 2007). Although the net rate of forest change has been positive since 1990, the proportion of closed woodland forest has decreased substantially in favour of less dense savannah forest. Population growth, measured at 2.4 per cent per year (UNESA 2005), coupled with heavy reliance on fuelwood, bush fires, and agricultural expansion are the primary drivers of forest degradation.

The mangroves and wetlands associated with the Gambia River account for one-fifth of the country's total land area (FAO 2005) and provide important habitat for much of the Gambia's floral and faunal diversity. Wetlands are threatened by

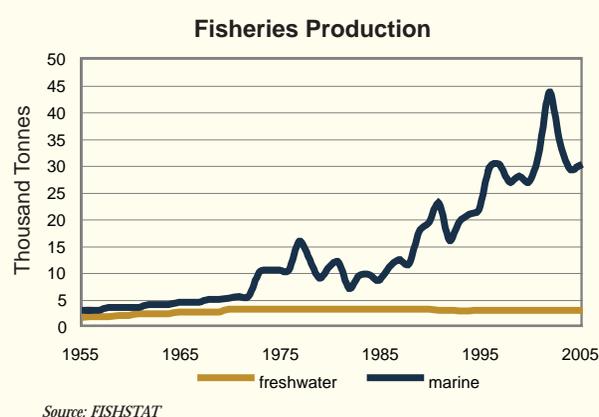
rice production and dry season livestock grazing; almost one-third of swamps have been cultivated (The Gambia Department of Parks and Wildlife Management 2006).



Overfishing and Coastal Erosion

The Gambia's marine fisheries are particularly productive due to the freshwater flow from the Gambia River estuary, which attracts both feeding and breeding fish. Recent studies show that demersal (near-shore) species are suffering from excessive fishing pressure, whereas pelagic (off-shore) species are vastly underexploited (FAO 2000-2007).

Intensive development of the Gambia's short coast has resulted in severe coastal erosion. In some areas, the shoreline is receding by one to two metres per year (UNESCO 2002), threatening nearly three-quarters of a million people, or 45 per cent of the country's population, who live on the coast.



T H E G A M B I A

ATLANTIC
OCEAN



Urban Sprawl: Greater Banjul Area, the Gambia

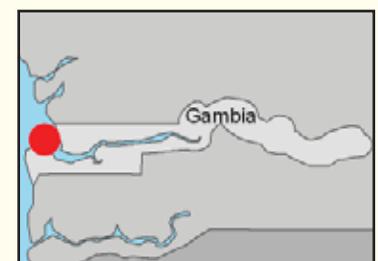
The Gambia's capital city, Banjul, is located at the end of a peninsula referred to as Banjul Island or St. Mary's Island. Banjul grew rapidly until the early 1980s, when commuter services from the surrounding area were developed. Easy access to Banjul led to dramatic population growth in the nearby Kanifing District, from less than 12 000 in 1963 to over 332 000 in 2003. The pattern repeated itself as the Kanifing District became crowded in the mid-1990s and services and amenities were made available in the areas south of Kanifing, inducing many people to move there.

T H E G A M B I A

ATLANTIC
OCEAN



The sprawl of greater Banjul has led to the loss of forest cover and arable land. It is also putting increasing pressure on the Tanbi Wetland Complex, a mangrove forest located between Banjul and Kanifing District. Tanbi was recently designated a Ramsar Wetland of International Importance. These images show the dramatic increase in urban development in the Banjul area between 1973 and 2006, particularly in the Kanifing District. Some forest blocks (deep green patches) have survived; most of them are designated forest reserves. The Abuko Nature Reserve, immediately southwest of the Tanbi Wetland Complex, increasingly contrasts with the developed areas around it. The Reserve was set aside in 1916 to protect a water catchment and was made a nature reserve in 1968.





Republic of

Ghana

Total Surface Area: 238 553 km²

Estimated Population in 2006: 22 556 000

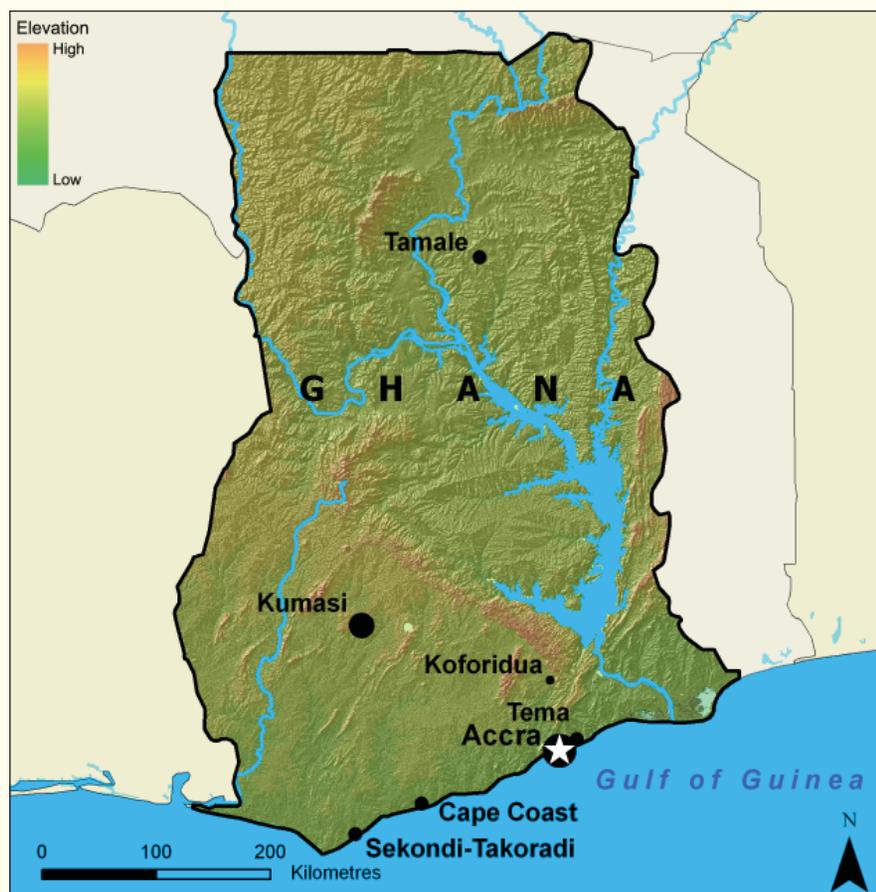


Ghana is relatively well-endowed with natural resources, including fertile soils, forests, and mineral deposits of gold, diamonds, manganese, and bauxite. The climate is generally tropical

and warm, with aridity increasing from south to north. Occupying central Ghana, the Volta River Basin drains nearly half of the country. While the coastal zone represents only 6.5 per cent of the total land area, it supports one-quarter of the population and most of the country's industries (Amlalo 2006).

Important Environmental Issues

- Deforestation
- Land Degradation and Coastal Erosion
- Overfishing and Reduced Water Volume in Lake Volta



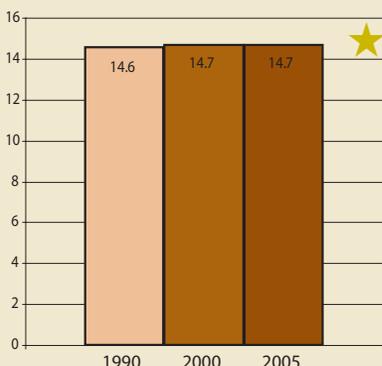
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

In less than 50 years, Ghana's primary rain forest has been reduced by 90 per cent, and between 1990 and 2005, the country lost 26 per cent of its forest cover. Overgrazing, heavy logging, overcutting of firewood, and mining have all taken a toll on forests and woodlands. About one-third of the land area is threatened by desertification, caused mainly by slash-and-burn agriculture and overcultivation of cleared land, resulting in widespread soil erosion and degradation.

★ Indicates progress

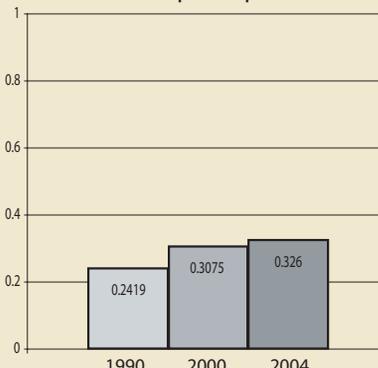
Protected area to total surface area, percentage



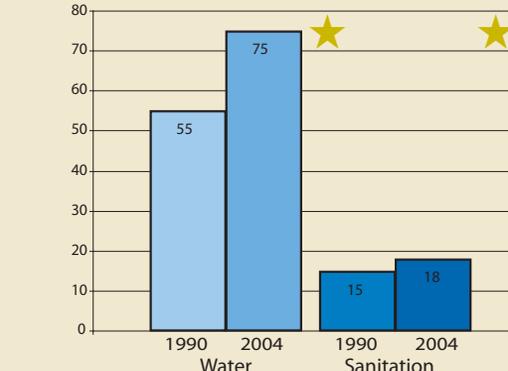
Land area covered by forest, percentage



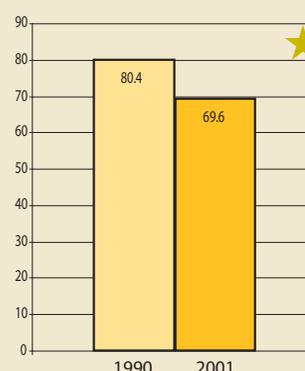
Carbon dioxide (CO₂) emissions, metric tonnes per capita



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

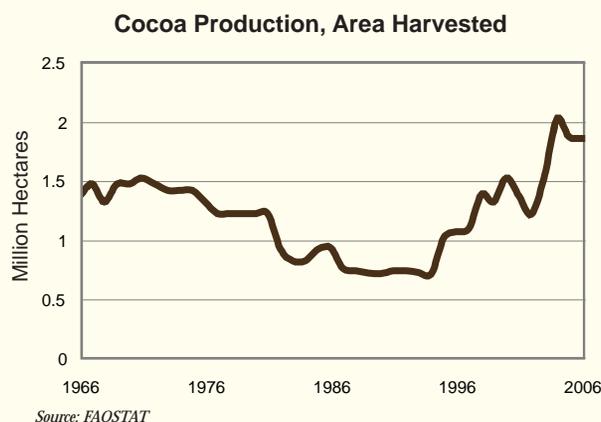


The closing of Akosombo Dam in the early 1960s flooded four per cent of Ghana's land and created the largest reservoir in the world by surface area, Lake Volta.

Deforestation

Ghana is the world's second-largest producer of cocoa beans (FAO 2007), and large tracts of tropical forest have been cleared to support increasing cocoa cultivation. When world cocoa prices are low, Ghana's foreign exchange earnings are significantly affected; this is often compensated for by increasing timber and mineral exports. Thus, cocoa farming is both a direct and indirect driver of deforestation.

Ghana has one of the highest deforestation rates in Africa at—two per cent annually (UN 2007). Timber harvesting and slash-and-burn agriculture are the greatest threats, but wildfires, mining, and rising demand for fuelwood are also important contributors.



Land Degradation and Coastal Erosion

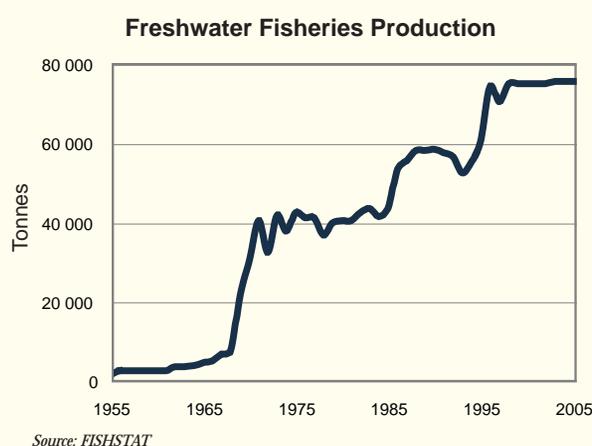
Despite relatively flat topography, nearly three-quarters of Ghana suffers from sheet and gully erosion (FAO 2005) and one-third of its land is affected by desertification (UNCCD 2002). Lowered water tables, siltation of rivers, and increased flooding are evidence of increasing aridity. Rapid deforestation and poor cultivation practices are largely responsible, although occasional droughts and wildfires intensify the problem. Furthermore, mining is a significant source of localised land degradation; the use of cyanide and other

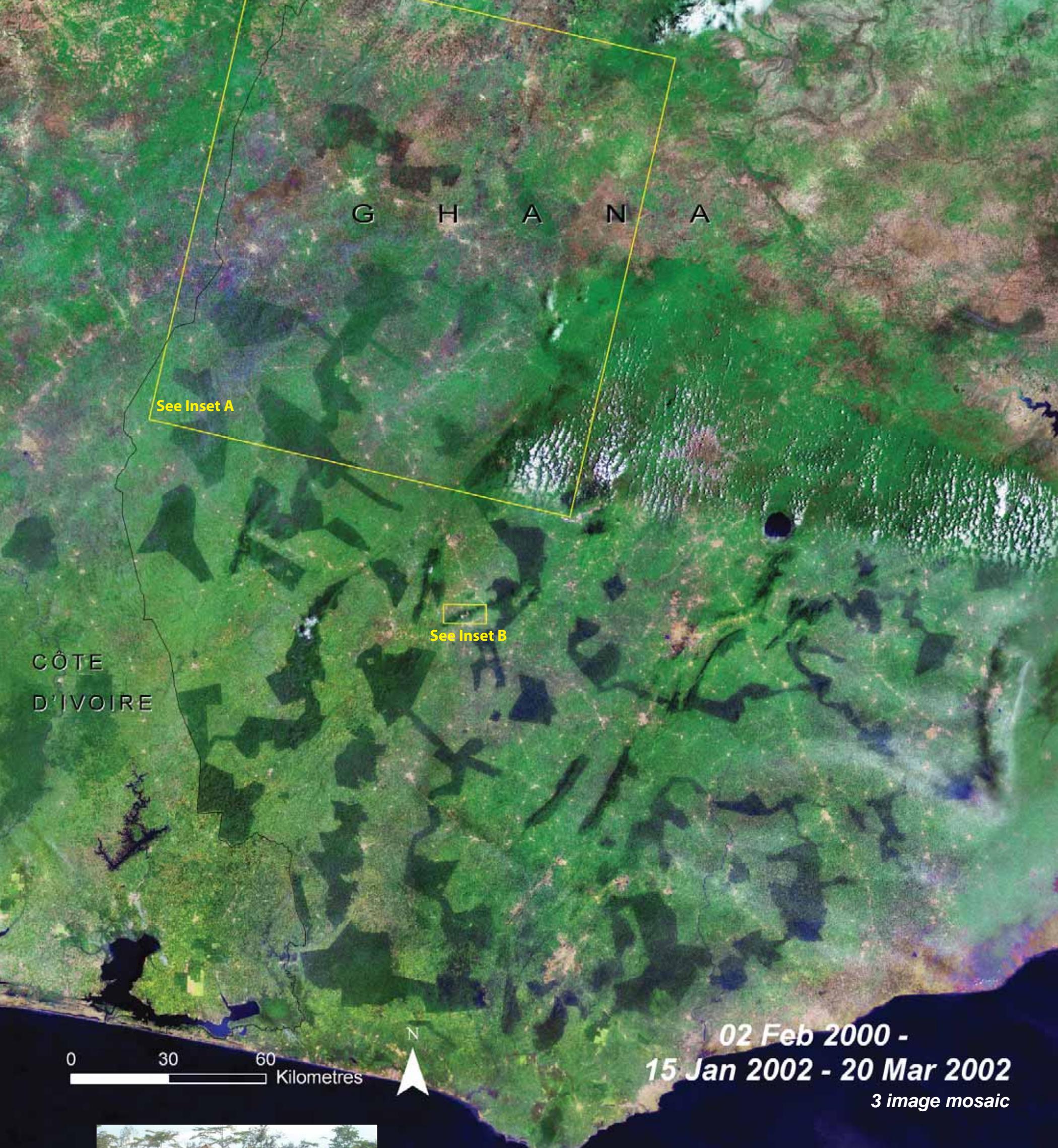
poisonous chemicals has contaminated surface and groundwater resources and rendered much land unusable for agriculture or forestry. Although most mining is controlled by international corporations, small-scale, illegal mining is pervasive.

On the coast, land degradation is a consequence of the heavy concentration of people and industries. Overexploitation of mangroves and rapid development are driving coastal erosion at an average rate of two to three metres per year (ACOPS n.d.).

Overfishing and Reduced Water Volume in Lake Volta

In the mid-1960s, the Akosombo Dam was constructed on the Volta River creating Lake Volta, one of the largest artificial water bodies in the world. With roughly 140 identified fish species, Lake Volta is the site of the most important inland fishery in Ghana. However, the maximum sustainable yield has been exceeded annually since 1995, causing fish catch to stagnate (FAO 2000-2007). Furthermore, the lake's water volume recently dropped to record low levels, affecting the dam's electricity-generating capacity. This is likely both a consequence of natural factors such as climate variability as well as human-induced problems such as soil erosion.

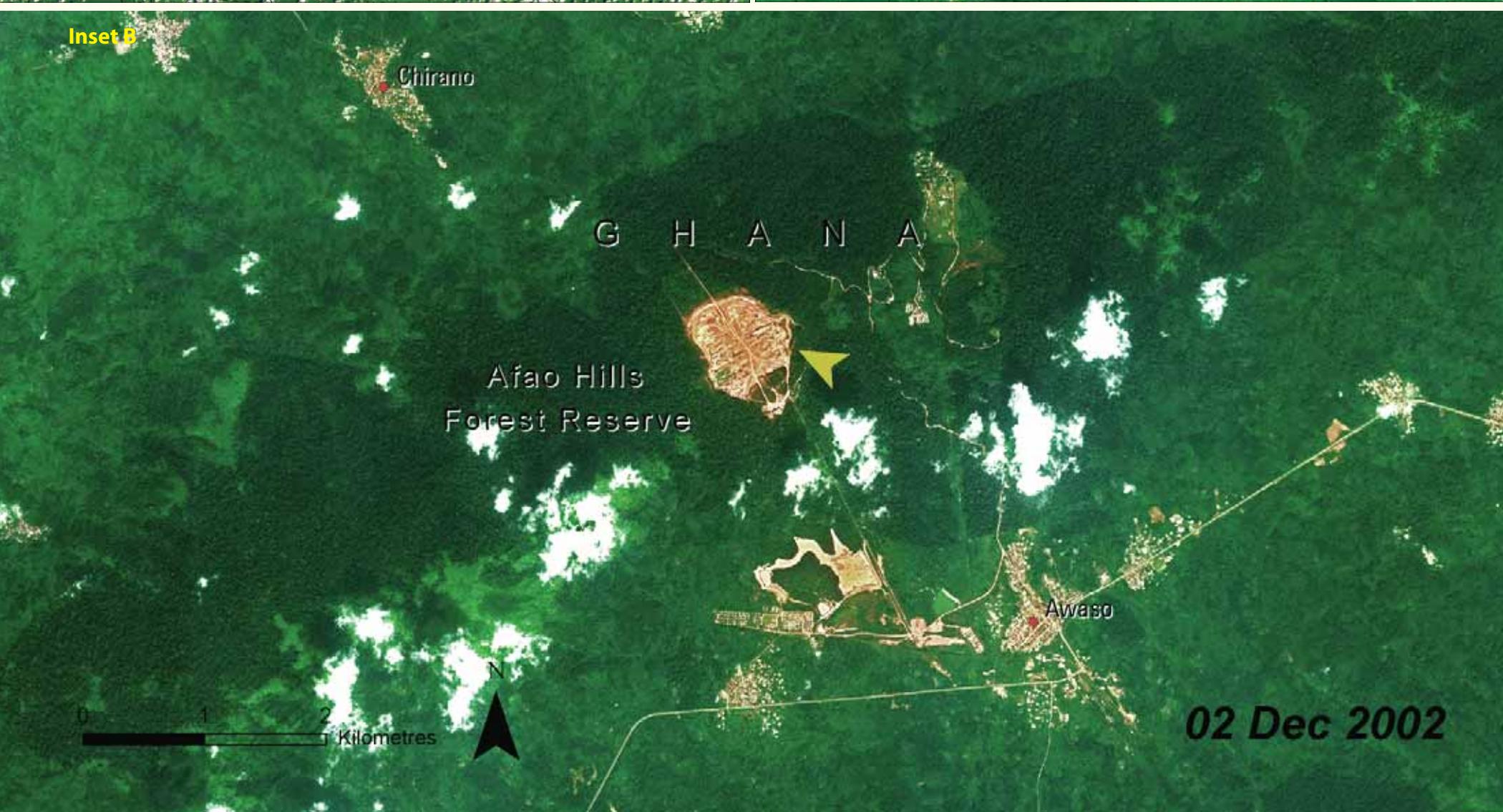
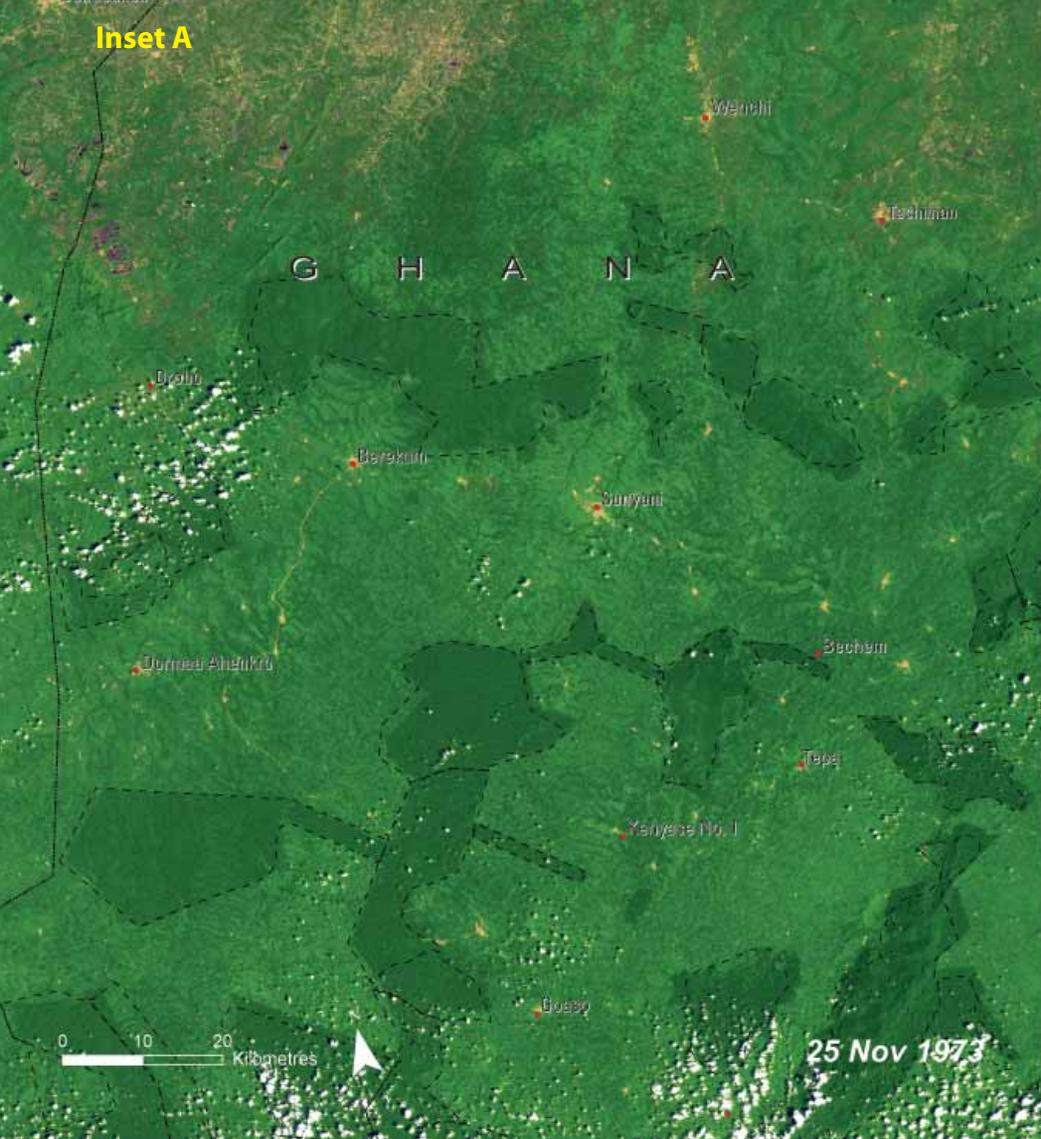




Forest Reserves Under Pressure: Ghana

The fragmented tropical forest of southwestern Ghana creates a fascinating pattern from space. The dark green patches seen above are reserves set aside early in the 20th century; they are the only significant blocks of forest remaining in the country. Recognizing this priceless ecological heritage, the Ghanaian government has developed policies for sustainable forest management.

In spite of the enormous ecological benefits of the forest and the government's effort to sustainably manage the reserves, shifting cultivation, uncontrolled logging, surface mining,



charcoal production, and increasing population place enormous pressure on these remnants of Ghana's tropical forests. In the 1973 image (top left) the vegetation inside and outside the protected areas appears green and robust. In the 2002/2003 (top right), dramatic change is apparent; some of the northern reserves have been decimated and the northern edge of the forest zone has moved south.

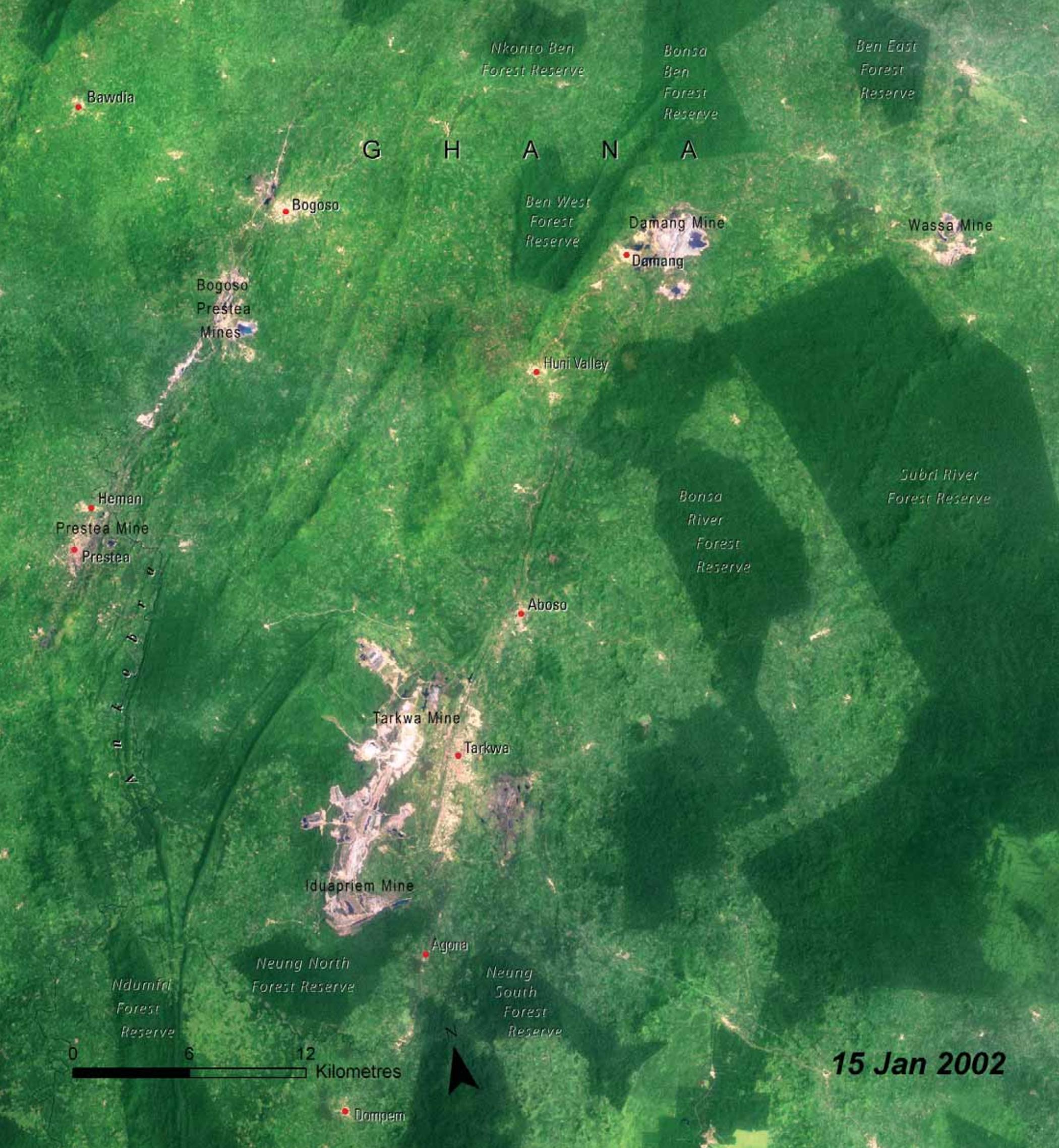
Recently, mines have been permitted within some of Ghana's forest reserves. On the advice of the International Monetary Fund (IMF), Ghana relaxed mining and logging regulations and nurtured investment by the mining and forestry industries through generous incentives during the 1980s and 1990s. Mines like the one within the Afao Hills Forest Reserve (yellow arrow on the bottom image) pose a serious threat to Ghana's remaining forests.





Gold Mining in Wassa West District: Ghana

With the encouragement and support of the World Bank, Ghana revised its mining laws in the 1980s, privatising the industry and liberalising regulation. This resulted in several hundreds of millions of dollars of foreign investments in Ghana's mining industry. While this brought gold production to new highs, replacing cocoa as Ghana's most valuable commodity, it also resulted in social and environmental impacts that are proving to be unpopular locally and internationally.



Over 60 per cent of the Wassa West District in western Ghana is now under concession to large-scale gold mining companies, the greatest concentration of mining in a single district in Africa. The large footprints of these open-pit mines directly result in significant forest loss. In addition, related infrastructure and associated population growth indirectly drive even greater land cover conversion. Significant portions of Wasa West's tropical rainforest have been degraded by or lost to this gold mining boom since the 1980s.

The mines in Wassa West have been kept out of the forest reserves, which can be seen as dark green areas with clear straight boundaries in both the 1986 and 2002 images. However, the 2002 image shows that the footprints of mining operations in the district have grown dramatically since 1986.



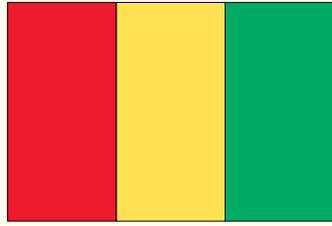


Republic of

Guinea

Total Surface Area: 245 857 km²

Estimated Population in 2006: 9 603 000



Guinea is a relatively small country with diverse geographic regions including a coastal plain, gently rolling savannahs, a mountainous plateau, and forested highlands. It is known as the “water tower of western Africa” due to the 22 major rivers originating within the country, which include the Niger and Senegal Rivers. The climate is tropical with one rainy season and one dry season. Precipitation is generally high and varies from roughly 1 200 mm per year in upper Guinea to 4 200 mm per year in lower Guinea (FAO 2005).

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Important Environmental Issues

- Deforestation and Refugees
- Overfishing and Destruction of Mangrove Forests
- Land Degradation



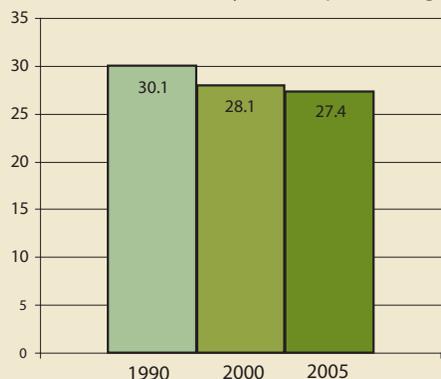
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

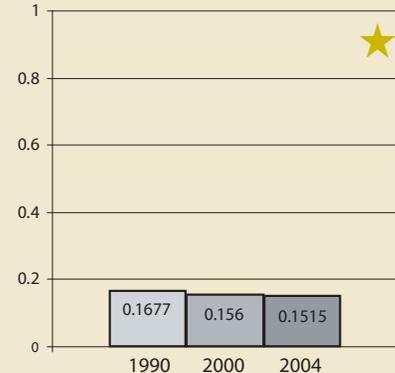
In Guinea, centuries of slash-and-burn agriculture have caused forested areas to be replaced by savannah woodland, grassland, or brush. Mining, the expansion of hydroelectric facilities, and pollution contribute to the erosion of the country’s soils and desertification. Dense mangrove forests grow along the mouths of Guinea’s major rivers, but the ecosystems are overexploited and are rapidly being lost.

★ Indicates progress

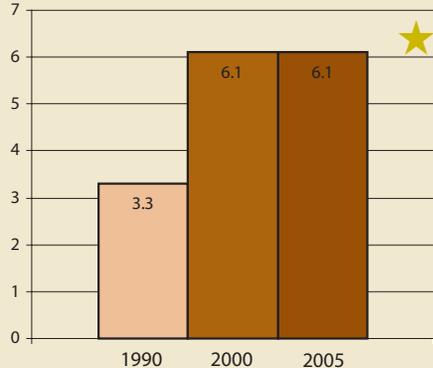
Land area covered by forest, percentage



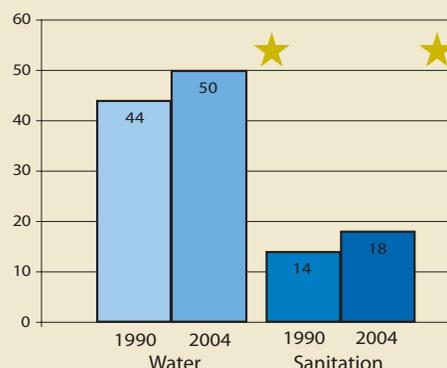
Carbon dioxide (CO₂) emissions, metric tonnes per capita



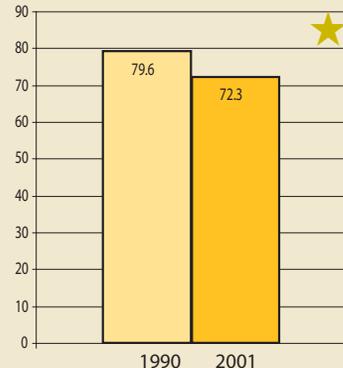
Protected area to total surface area, percentage



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban

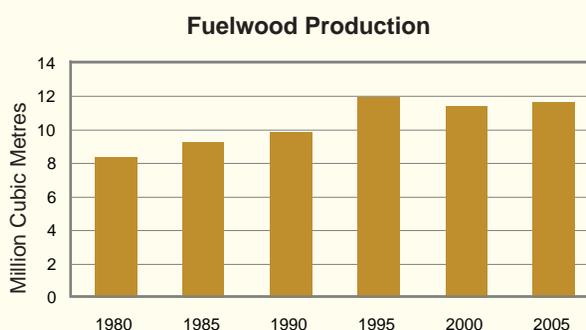


Guinea has the world’s largest bauxite reserves and is the world’s number one exporter of bauxite ore.

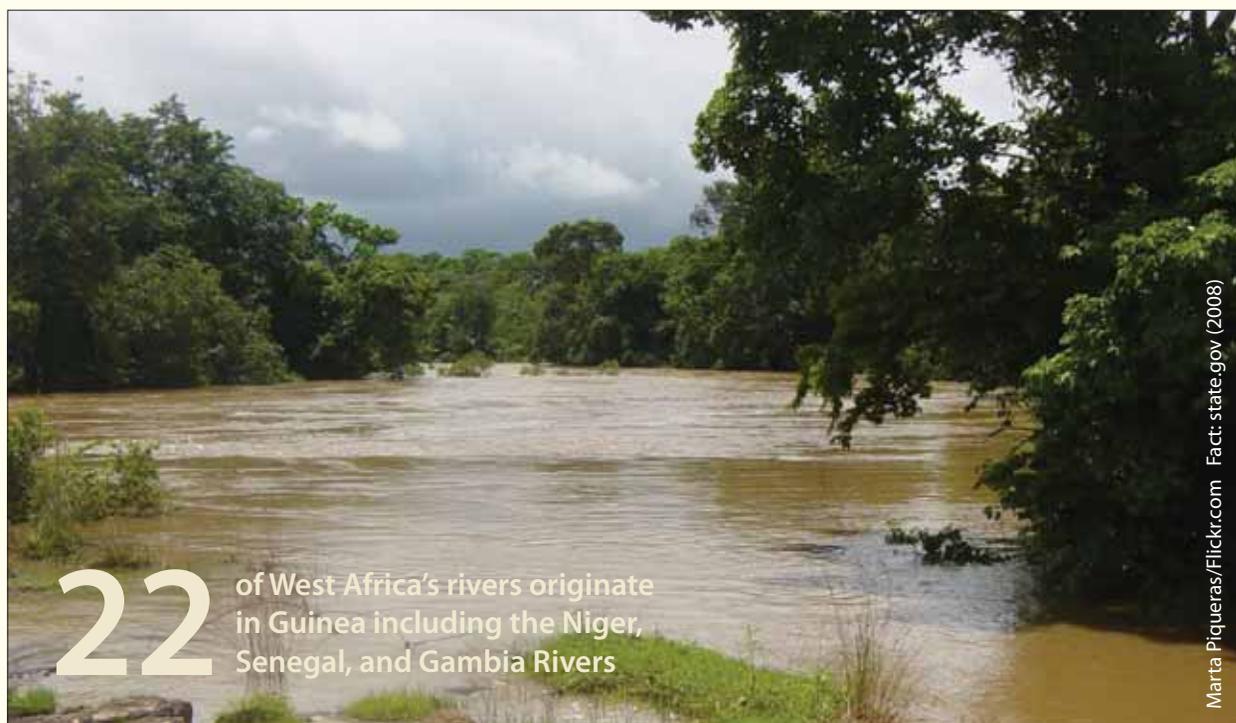
Deforestation and Refugees

Less than one-third of Guinea is now forested, reflecting many decades of uncontrolled deforestation. The primary drivers include growing demand for agricultural land and dependence on wood and charcoal for 90 per cent of all energy needs. The humid tropical forests of southeast Guinea have been reduced to less than five per cent of their original extent (CBD 2002). This is in part due to an influx of at least 600 000 refugees from Sierra Leone, Liberia, and Côte d'Ivoire during the past 15 years, which has placed increased demand on forest resources. Refugees have expanded the local populations by as much as 40 per cent in some areas,

resulting in local population densities close to 400 people per square kilometre (CBD 2002).



Source: FAOSTAT

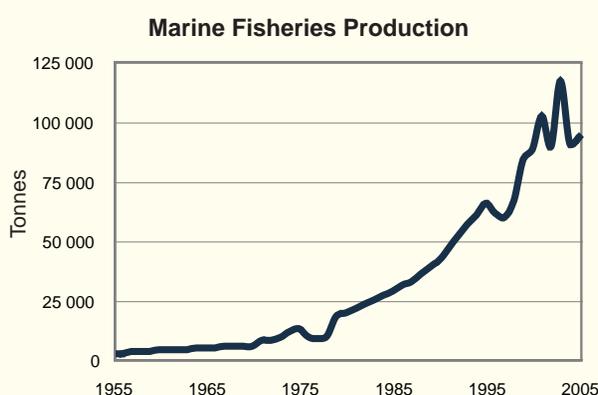


22 of West Africa's rivers originate in Guinea including the Niger, Senegal, and Gambia Rivers

Marta Piqueras/Flickr.com Fact: state.gov (2008)

Overfishing and Destruction of Mangrove Forests

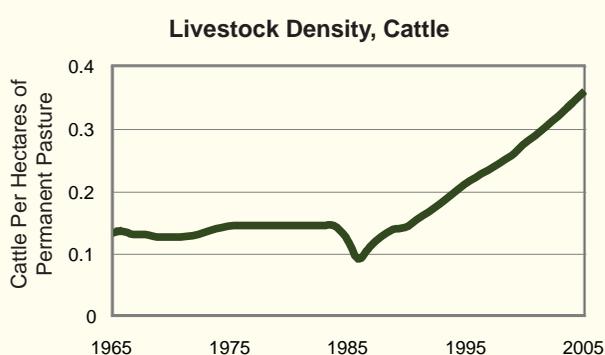
Guinea's marine fisheries sector has grown dramatically in recent decades, resulting in the overexploitation of certain commercial species and declining stocks. Those species traded internationally and exploited by foreign trawlers are particularly threatened. Fish populations are also endangered by the loss of coastal mangrove forests, which provide important shelter and breeding habitat. Since 1965, mangroves have been lost at an average rate of 4.2 per cent per year (CBD 2002). Salt production reached 30 000 metric tonnes per year in 2002, requiring 93 000 metric tonnes of fire wood from mangrove forests to fuel the process (CBD 2002).



Source: FISHSTAT

Land Degradation

Agriculture employs 82 per cent of the population in Guinea (FAO 2005) and is a leading cause of land degradation. Cropped area has expanded



Source: FAOSTAT

significantly in recent decades, although most cultivation is characterized by low availability of inputs and mechanization, resulting in reduced soil fertility and low yields. Similarly, cattle stocks have increased nearly three-fold since 1961, thereby increasing grazing intensity.

Mining, which accounts for over three-quarters of export earnings in Guinea, is also responsible for substantial land degradation. Due to insufficient regulation, many open-pit mines have been abandoned without rehabilitation and wastes have been left to pollute the soil and water. One estimate suggests that 1 118 hectares of land had been affected as of 1994 (Campbell 1997).



Rob Rogoyski/Flickr.com



A City Between the Mangroves: Conakry, Guinea

Natural resources in Guinea's coastal zone are crucial to local economies, which depend on their immediate environment for freshwater, fuelwood, fisheries, and agriculture. Guinea's coastal zone is also home to one-fourth of West Africa's mangroves, which are linked to the vitality of the terrestrial and marine ecosystems that they bridge. These resources are being exploited at an unsustainable pace due to rapid population growth which without changes in resource management practices will lead to irreversible environmental degradation.



Population in Guinea's resource-rich coastal zone nearly tripled between 1963 and 1996. In the capital of Conakry, rural-to-urban migration, including refugees from Liberia and Sierra Leone in the 1990s, dramatically increased the population. Estimated at approximately 39 000 in the 1960s, Conakry's population had increased to nearly two million by 2006. Conakry's growing population puts intense pressure on the surrounding woody savannahs and mangroves, which are being converted to agriculture and exploited for fuelwood.

Conakry was founded on Tombo Island at the tip of Kaloum Peninsula. Its growth since then has followed the peninsula, hemmed in on either side by mangrove forests. In the 1975 image, dense settlement has reached the airport and beyond, but natural vegetation still covered much of the area. By 2007, however, nearly all of that vegetation has been overtaken by Conakry's rapid growth.





Mining a "Hotspot": Sangaredi Mine, Guinea

The Sangaredi Mine in the Upper Guinea Forest falls within one of the world's most biologically rich, yet seriously threatened, ecosystems. Recent biological assessment of the area surrounding the bauxite mine and proposed alumina processing facility identified five reptile species, 17 amphibian species, 140 species of birds, 16 species of mammals, and eight primate species, including the endangered West African chimpanzee and western red colobus.

The Sangaredi Mine is Guinea's largest and most profitable. A proposed alumina refinery, sited approximately 25 km to the west of the mine, is expected to bring a US\$3 000 million capital



investment, thousands of jobs, and infrastructure development. The consortium which is building the refinery is working with Conservation International to incorporate ecological considerations into the plans. A biological assessment of the area was conducted as a part of that process.

Bauxite mines and alumina refineries typically create serious ecological problems. Bauxite ore is mined in open pits, requiring the removal of vegetation and topsoil. In the 2007 image, the Sangaredi Mine is visible as a vast open pit approximately 20 km from one end to the other. Alumina refining produces highly caustic “red mud” that negatively affects surface and groundwater quality. In addition to direct environmental impacts, the increased population and infrastructure development associated with the mine will likely put immense pressure on this environmental “hotspot.”



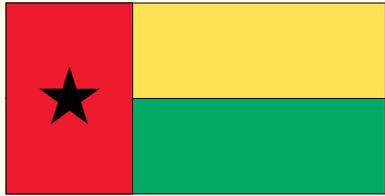


Republic of

Guinea-Bissau

Total Surface Area: 36 125 km²

Estimated Population in 2006: 1 634 000



Guinea-Bissau is a small country bordering the Atlantic Ocean, lying primarily on a flat coastal plain no more than 40 m above sea level. Over half

of the country's 1.7 million inhabitants live in this coastal zone and one-third of the population lives in cities. In the east, the terrain rises to a low savannah, eventually attaining a maximum elevation of 300 m. Just offshore, the Bijagos Archipelago comprises over 80 islands and is the only deltaic archipelago on Africa's Atlantic coast.

Important Environmental Issues

- Deforestation
- Cashew Farming and Soil Erosion
- Threats to the Bijagos Biosphere Reserve



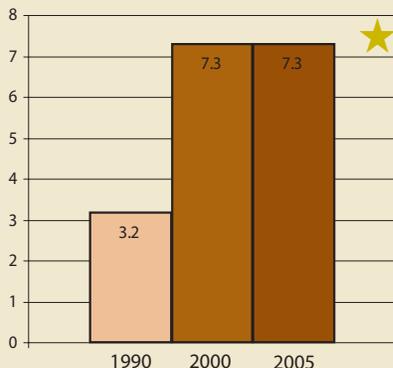
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

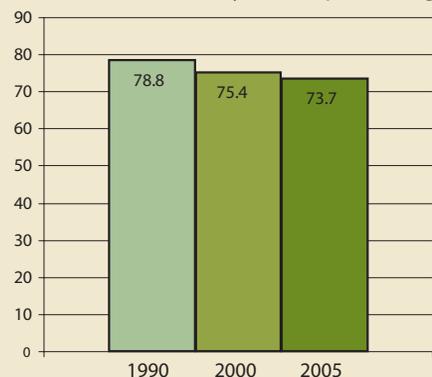
In Guinea-Bissau, fire destroys 40 000 hectares of land per year and contributes to the country's deforestation rate of about 570 km² per year. Guinea-Bissau lost over 75 per cent of its original mangroves by the mid-1980s; the remaining mangroves—some of the most important in Africa—are still giving way to rice fields and hydroelectric projects. However, thanks to a small population and minimal industry, Guinea-Bissau has few other serious environmental problems.

★ Indicates progress

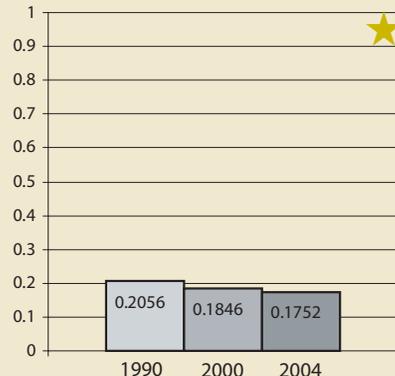
Protected area to total surface area, percentage



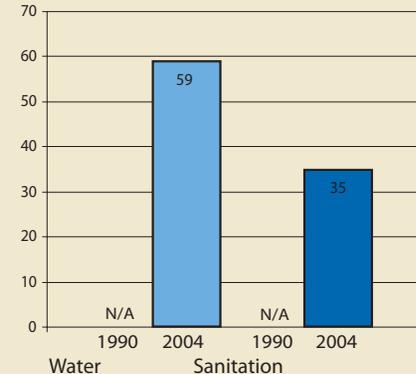
Land area covered by forest, percentage



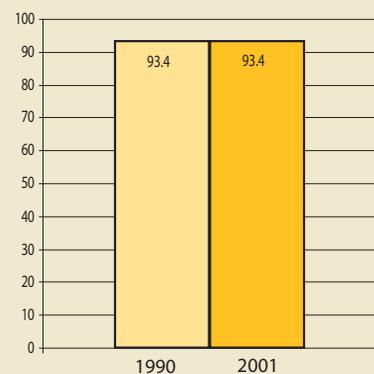
Carbon dioxide (CO₂) emissions, metric tonnes per capita



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



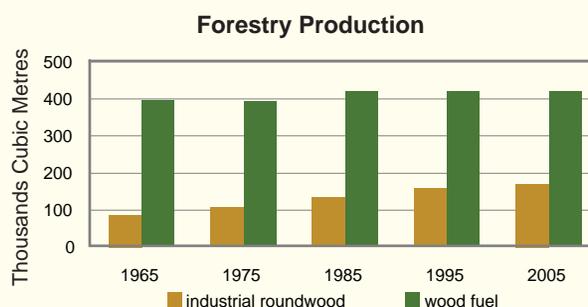
Slum population as percentage of urban



Guinea-Bissau is the world's sixth largest producer of cashew nuts, which account for over 90 per cent of its export earnings.

Deforestation

Nearly three-quarters of Guinea-Bissau is forested (UN 2007), of which nearly half is considered primary forest (Mongabay 2006). Although the deforestation rate is currently only 0.5 per cent per year, (FAO 2005) the country is enduring rapid population growth and development despite being one of the smallest African countries. Mangrove forests are increasingly giving way to rice cultivation, hydroelectric projects, and charcoal production.

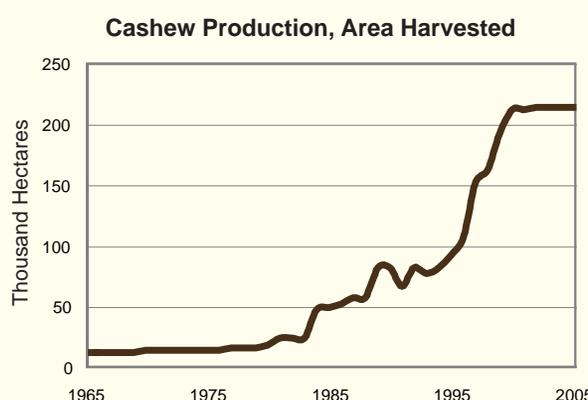


Source: FAOSTAT

Cashew Farming and Soil Erosion

Over four-fifths of the population in Guinea-Bissau is involved in agriculture (FAO 2006); cashew nuts, rice, and livestock are the primary commodities. Overgrazing and rapid expansion of cultivated land have resulted in significant land degradation: 75 per cent of soils are moderately eroded (FAO AGL 2003).

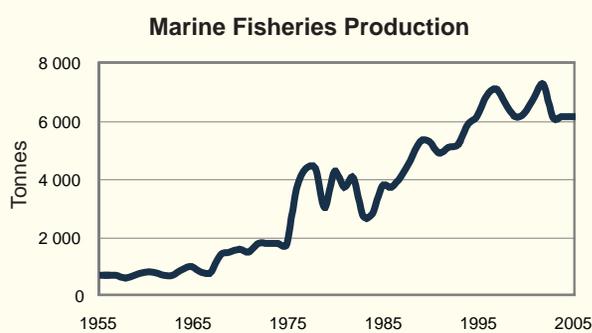
In particular, cashew farming has grown dramatically over recent decades to become the most important cash crop and source of export earnings for Guinea-Bissau. However, increasing production of cashew nuts has come at the expense of food crops, leaving food security vulnerable to fluctuations in the global cashew market.



Source: FAOSTAT



Threats to the Bijagos Biosphere Reserve

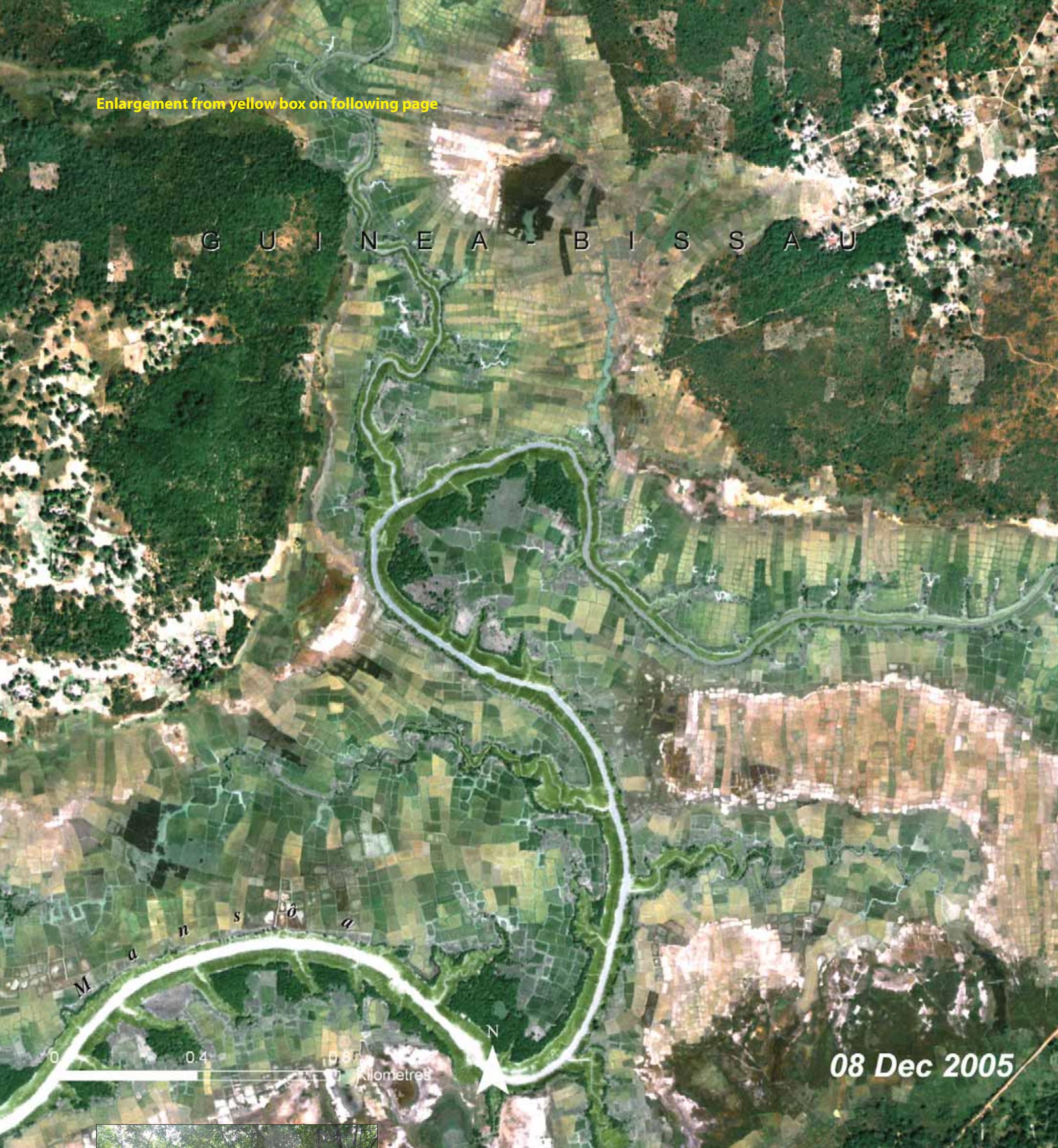


Source: FISHSTAT

The Bijagos Islands cover an area of nearly 10 000 km² and support over 25 000 inhabitants. The islands contain diverse ecosystems including mudflats, mangroves, and savannah grasslands, which in turn support a multitude of floral and faunal species. The Bijagos Biosphere Reserve protects 60 km² of this territory, including one of the most important green turtle breeding grounds in the eastern Atlantic. Threatened by overfishing, the reserve has been declared a no-fishing zone, but enforcement has been a challenge.



Enlargement from yellow box on following page



Balanta Rice Farming: Gêba Estuary, Guinea-Bissau

Rice is a major crop and staple food in Guinea-Bissau. The production of paddy, or “wetland,” rice started in the late 17th and early 18th centuries, when the Balanta (the country’s largest ethnic group) started organising men and women for agricultural production. Rice paddies have replaced many of the mangroves along the Gêba and Mansôa Rivers to the north of the capital, Bissau (2007 image).

These rice paddies are built by cutting a path through the mangroves and piling up mud to form a dike that will keep back the tide. The mangroves, cut off from the ocean, quickly die.



The ground is then burned to clear remaining undergrowth. After the paddies are constructed, their walls trap rainwater, in which rice will grow.

The 2007 image (above right) shows several dark green belts of mangrove forests adjacent to the Gêba and Mansôa Rivers. Intensive rice farming is indicated by the light-grey areas bordering these mangroves. This pattern is observed around Bissau, as well as the smaller towns of Cufar, Mansôa, Bissassema de Cima, and Nã Balanta. The 2005 high-resolution image (above left) shows the intensity of rice cultivation in an area near Cufar (from yellow box, above right). Inundated rice paddies (whitish rectangles) and rice fields (light- to dark-green rectangles) surround the meandering river. Only isolated patches of mangroves (deep-green) remain along much of the river.



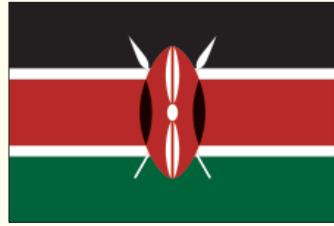


Republic of

Kenya

Total Surface Area: 580 367 km²

Estimated Population in 2006: 35 106 000



Kenya's diverse climate ranges from tropical along the Indian Ocean coast to arid in the extreme north. Highland areas in the centre of the country, the location of Africa's second

highest peak—Mount Kenya, are bisected by the Great East African Rift Valley. Drylands account for 88 per cent of the total surface area and provide essential habitat for approximately 50 per cent of livestock and 70 per cent of Kenya's wildlife (UNCCD 2002).

Important Environmental Issues

- Water Scarcity and Pollution
- Desertification and Deforestation
- Degradation of Freshwater Ecosystems



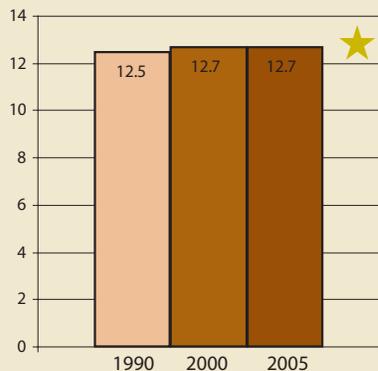
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

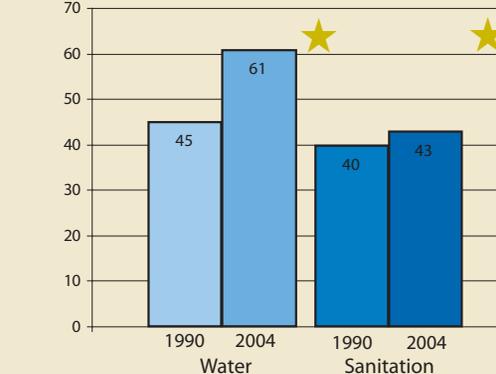
Deforestation, soil erosion, and water pollution from urban and industrial wastes are three environmental concerns for Kenya. Eighty-three per cent of Kenya's land area is vulnerable to drought and desertification. Nevertheless, Kenya's protected areas have increased to over 30 national parks and reserves.

★ Indicates progress

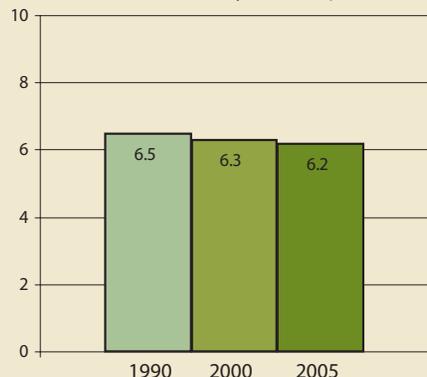
Protected area to total surface area, percentage



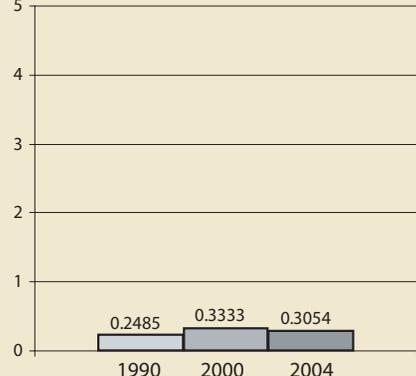
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



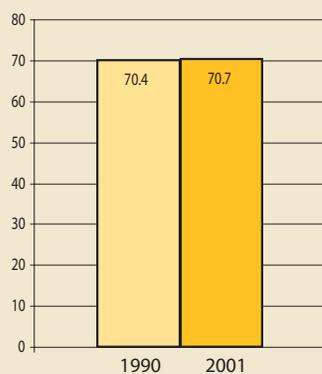
Land area covered by forest, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



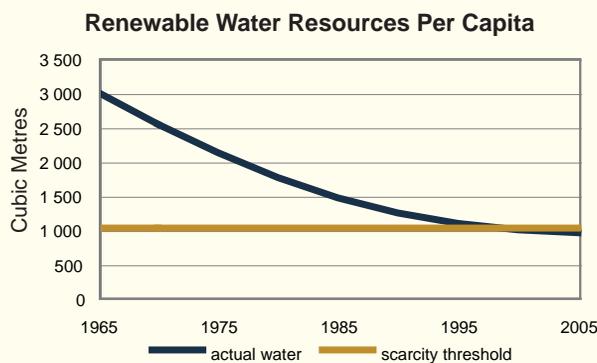
Slum population as percentage of urban



Kenya is world-famous for wildlife safaris to areas like Amboseli and Nakuru National Parks, and the Maasai Mara Game Reserve.

Water Scarcity and Pollution

Kenya is below the international water scarcity threshold (1 000 m³ per person per year (UNEP 2002)) with only 935 m³ available per person per year (FAO 2007), and population growth is forecast to reduce this figure to 359 m³ by 2020 (UN-Water 2006). Increasing industrial and urban pollution is an additional threat to freshwater resources. Kenya has one of the largest industrial sectors in sub-Saharan Africa, and proper waste disposal is rare within city slums, which accommodate 71 per cent of all urban dwellers (UN 2007). Nairobi's Kibera slum is one of Africa's largest, with nearly one million people occupying only two square kilometres of land.

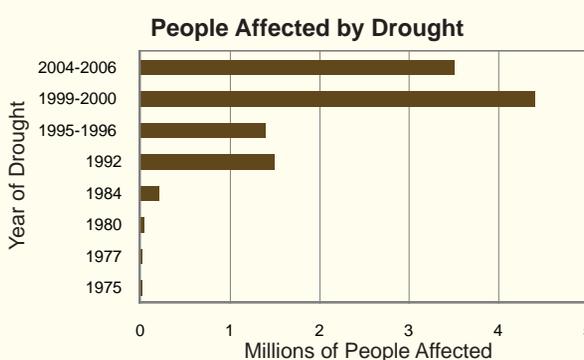


Desertification and Deforestation

The Kenyan Highlands are some of the most agriculturally productive lands in Africa. However, high population density—nearly three-quarters of the population occupies only 12 per cent of the country area (UNCCD 2002)—has put extensive pressure on arable land. In the arid and semi-arid regions where livestock are grazed, recurring drought exacerbates desertification and threatens the livelihoods of over 3.5 million pastoralists (IRIN 2006).

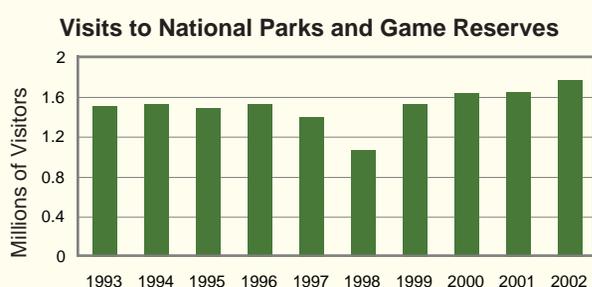
Widespread deforestation is also contributing to desertification. Much of Kenya's original forest cover has been lost and currently only six per cent of land is forested (UN 2007). Reforestation initiatives have failed to negate the combined effects of population

growth, high dependence on fuelwood and charcoal, and overexploitation by commercial loggers.



Degradation of Freshwater Ecosystems

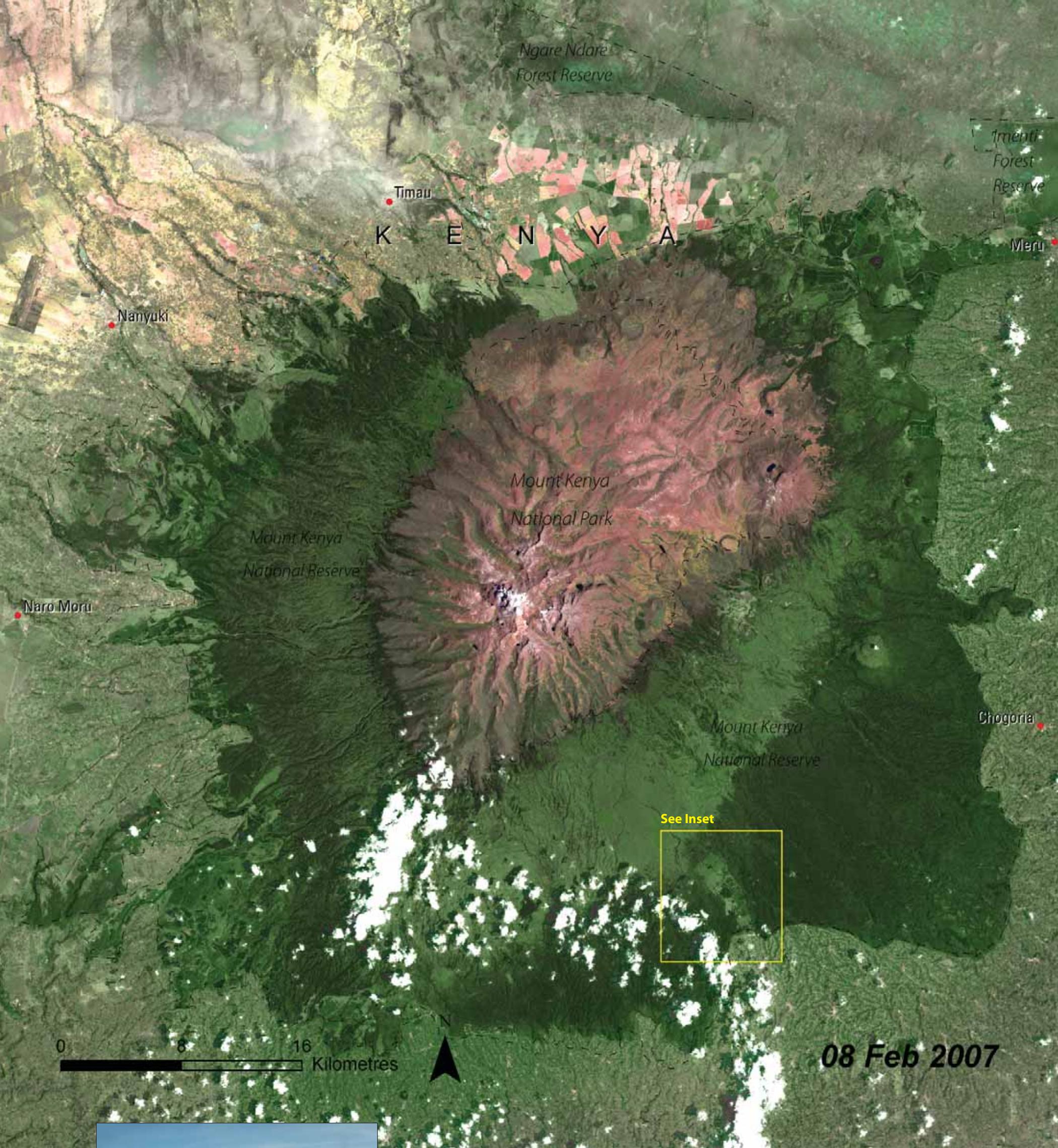
Kenya is world renowned for its biologically rich national parks, which attract nearly two million tourists each year (UN-Water 2006). Among them, Lake Nakuru National Park is famous for the



millions of flamingos that feed on its shores. Both a UNESCO World Heritage Site and Ramsar Wetland of International Importance, Lake Nakuru is threatened by siltation from surrounding agricultural activities and industrial and domestic effluent from nearby Nakuru Town (UNESCO 1999).

Lake Victoria—which accounts for most of Kenya's freshwater fish production and is shared by Uganda and United Republic of Tanzania—is similarly threatened. Increased nutrient input from agricultural runoff and the spread of the invasive water hyacinth plant have significantly reduced water quality.

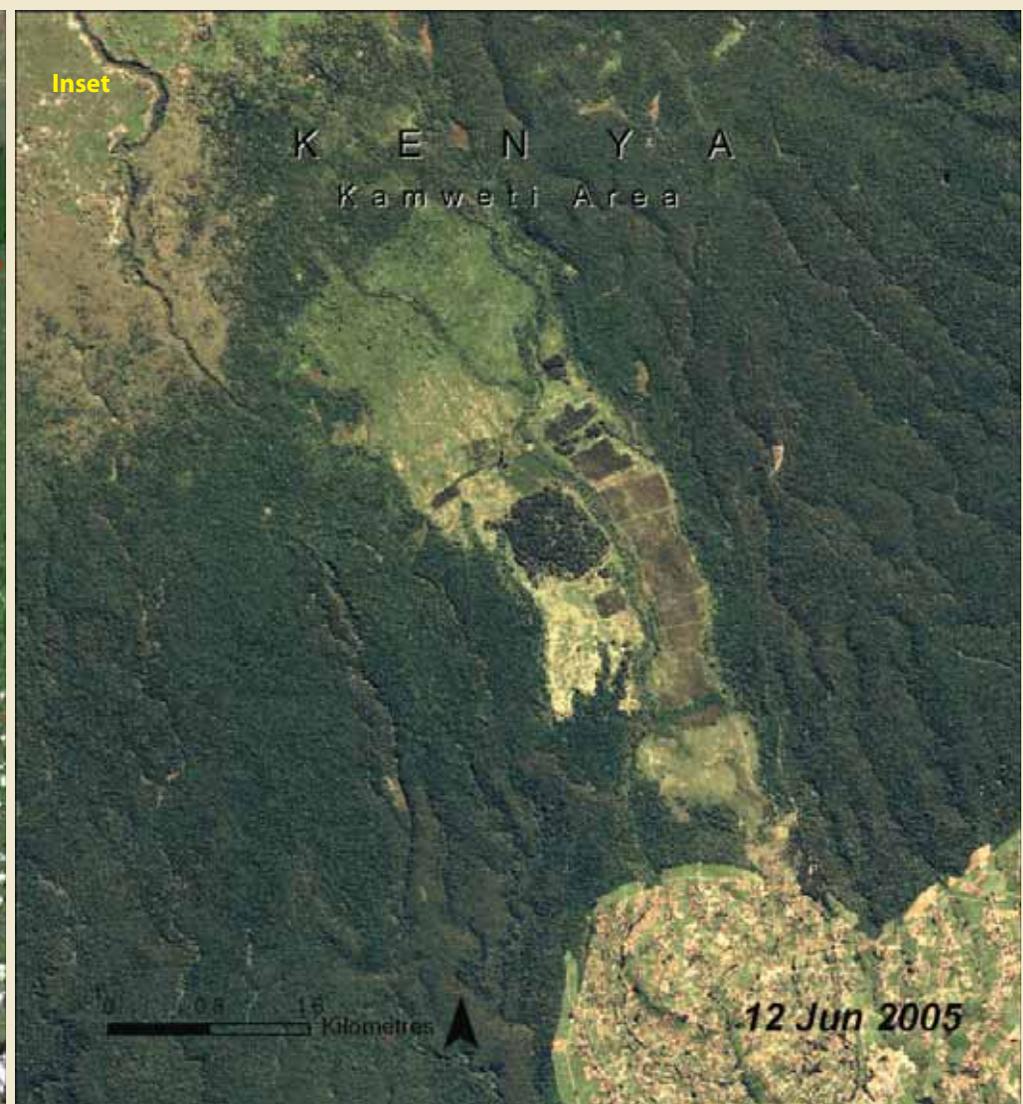
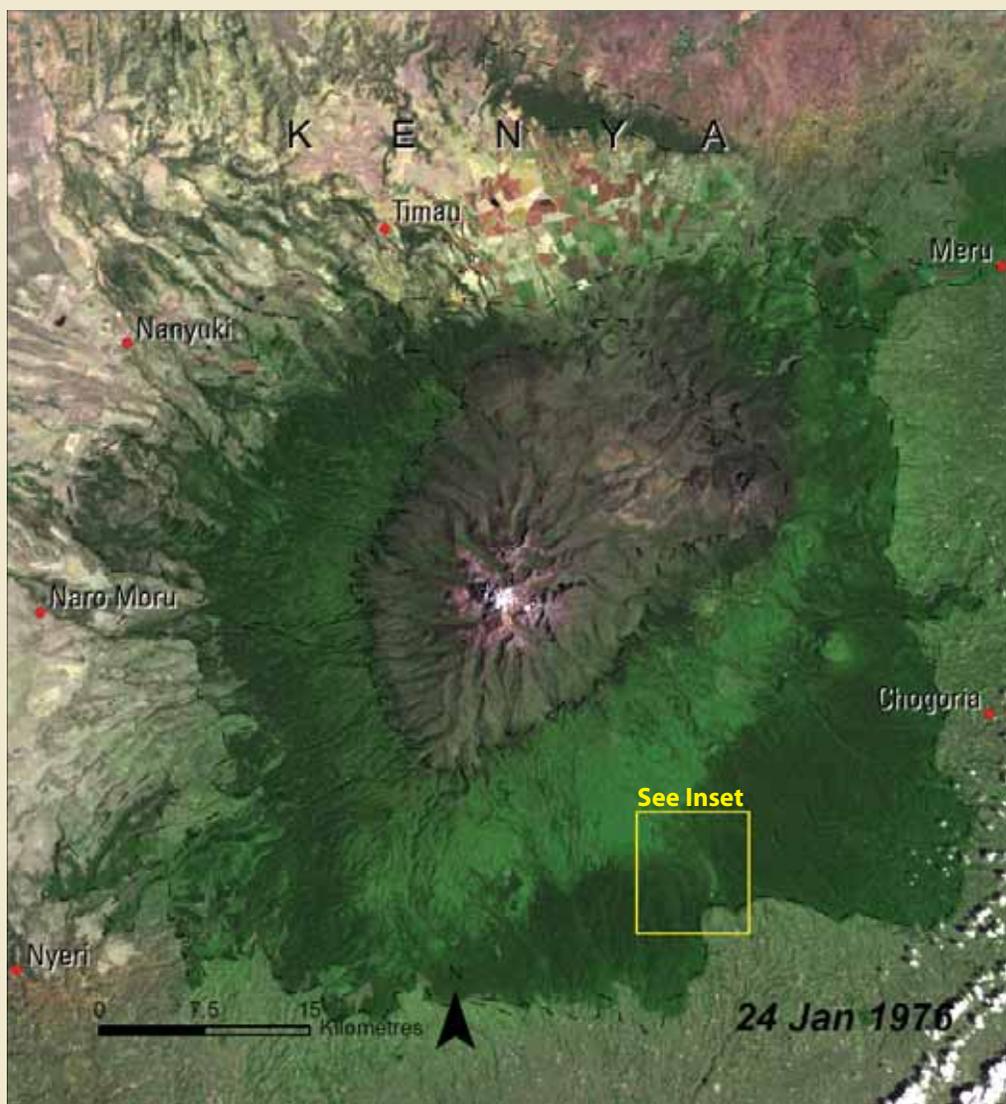




Christian Lamberth/UNEP

Protection and Management: Mount Kenya, Kenya

Mount Kenya has been described as one of the most impressive landscape features in East Africa. In addition to its beauty and value for timber, farmland, and tourism, it is a critical water catchment for Kenya and crucial to hydro-power generation on the Tana River. Depending on altitude and rainfall, there are a variety of different ecosystems on Mount Kenya, which are visible to some degree as various shades of green in the 2007 satellite image above.



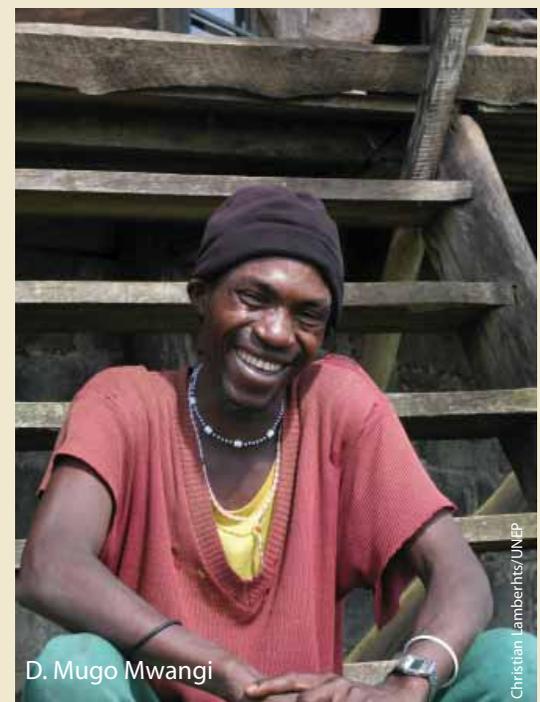
A Return to the Forest

Kamweti, part of Mount Kenya's protected forest, (see inset above) was long ago covered with moist montane indigenous forests that were cleared to create forest plantations. The plantations were established using the "shamba system", where farmers are allowed to inter-crop tree seedlings with annual agricultural crops until trees over-shadow the crops. At this point the farmers are expected to leave the area.

The shamba system was poorly implemented in Kamweti, as large areas remained devoid of trees indefinitely and were instead cultivated intensively with annual crops, converting what should have been forest plantations into settlements. Illegal logging, charcoal production, and poaching increased tremendously, posing major threats to neighbouring indigenous forests. To protect the forests the government moved the farmers out of Kamweti from the mid-1980s to the mid-1990s.

However, illegal activities in the forests continued unabated. In response, the government upgraded the Mount Kenya Forest Reserve to a National Reserve and charged its management to the Kenya Wildlife Service in 2000. This change led to a significant improvement in forest conservation. After the illegal activities were curbed, the forest began regenerating and wildlife, particularly elephants, returned, making Kamweti a beautiful tourist destination.

D. Mugo Mwangi was born in 1978 in Kamweti, where his parents cultivated fields of cabbages and potatoes. He still remembers the difficult times they faced when they had to leave the forest. Today, his parents have a small house in the village of Kimunye near the National Reserve. Mugo is back in the forest, not as a farmer, but as the caretaker of Robert's Hut, a small tourist facility located high up in the Kamweti area.



D. Mugo Mwangi



Kamweti Forest

After independence in 1963, the Kenyan government encouraged settlement of the Mount Kenya region and over a period of roughly forty years population increased ten-fold. In the late 1990s it was recognized that this intense population growth, along with misuse of non-resident cultivation policies, illegal charcoal production, illegal forestry, and marijuana cultivation were threatening the future of Mount Kenya. New policies and improved enforcement have significantly reduced unsustainable exploitation of the mountain's forests.

Continued monitoring and management of this majestic mountain is aimed at maintaining its immeasurable value for future generations. Sustainable uses such as eco-tourism help provide employment without undermining the essential ecosystem functions and invaluable biodiversity of this natural asset.

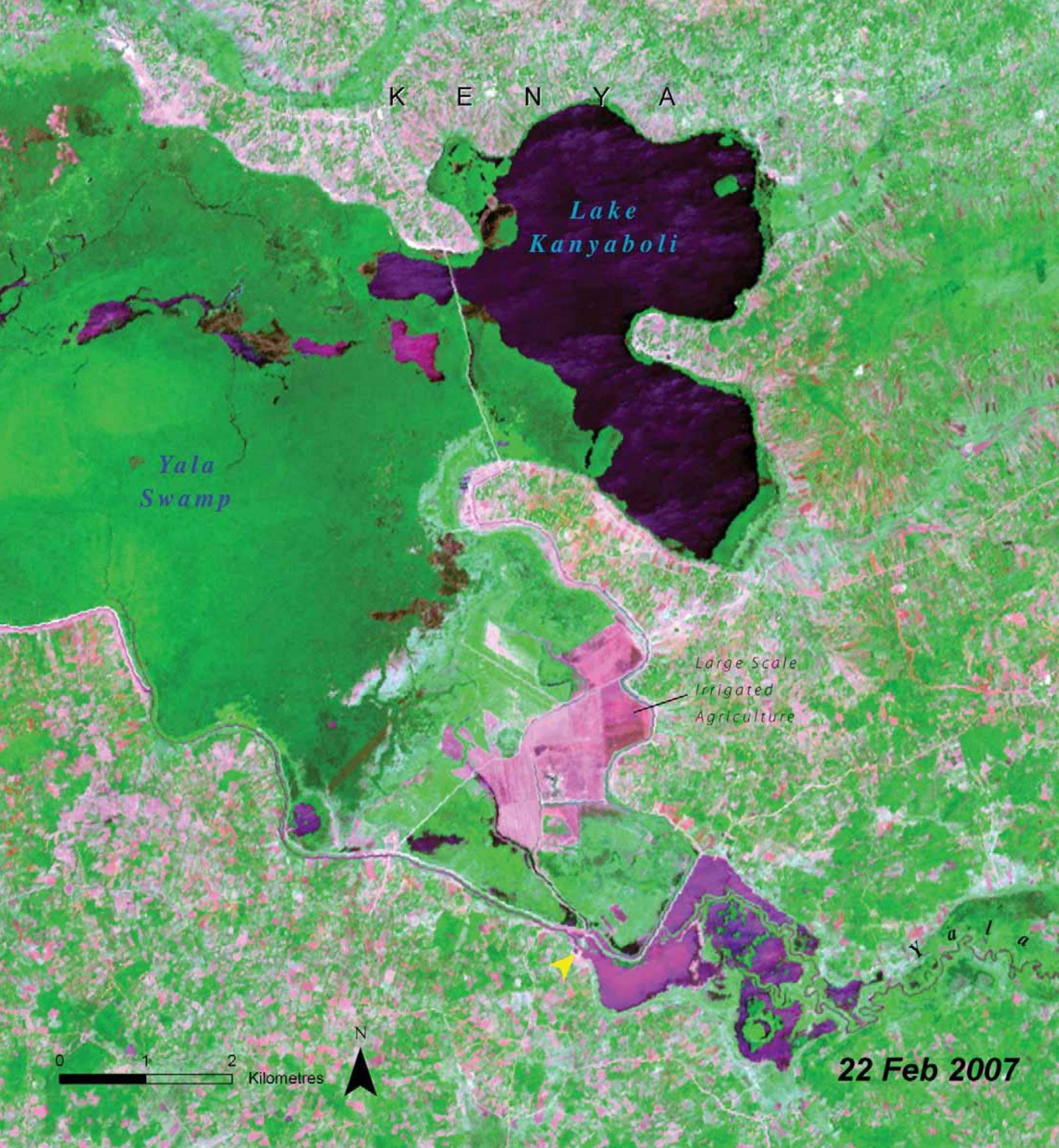




Irrigated Agriculture: Yala Swamp, Kenya

Yala Swamp is located in western Kenya, on the northeastern shore of Lake Victoria. It is the third-largest wetland ecosystem in the country, after Lorian Swamp and the Tana River Delta. The swamp provides a habitat for many plants and animals, some of which are extinct in the larger lake ecosystem and others that are endemic to the swamp.

Nutrient rich sediments deposited by the Yala River and the availability of water makes Yala Swamp particularly attractive for agriculture, including the intensive production of rice, cotton, and various other irrigated cash crops.



The development of this area has pitted the Kenyan government and private investors against conservationists. While the government and the investors argue that a well-planned exploitation of part of this area can help alleviate hunger and poverty in the region, conservationists feel that the Yala Swamp is too important an ecosystem to be disturbed for any economic gains.

These two images show the area before and after development of the region began. The small farm parcels in the 2002 image have largely been replaced by larger parcels, as is evident in the 2007 image. A dam (yellow arrow) has also been erected on the river, to provide water for irrigation.





Kingdom of

Lesotho

Total Surface Area: 30 355 km²

Estimated Population in 2006: 1 791 000



Lesotho is a small, mountainous country surrounded entirely by the Republic of South Africa. Almost two-thirds of the country is mountainous, rising to a maximum elevation of

3 482 m, which is the highest point in southern Africa (Lesotho National Environment Secretariat 2000). The majority of the population, however, resides in the more fertile lowland region to the west. The climate is temperate and water resources are generally abundant, although somewhat irregular: 85 per cent of rainfall occurs during the summer months (Lesotho National Environment Secretariat 2000).

Important Environmental Issues

- Degradation of Rangelands
- Threats to Biodiversity in the Lesotho Highlands
- Water Resource Management and Pollution



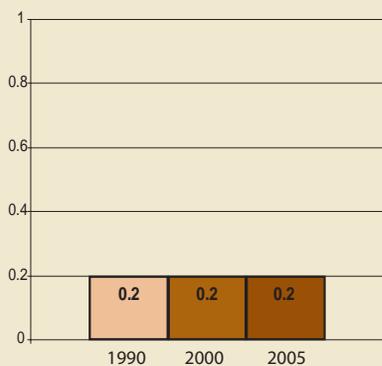
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

The remarkable increase in the number of people with access to improved water sources could be attributed to the Lesotho Highlands Water Project, developed in partnership between the governments of Lesotho and South Africa. This is Africa's largest water transfer scheme. In spite of issues including severe soil erosion, soil degradation, and desertification, the Highlands Water Project aims to control, store, and redirect water to South Africa.

★ Indicates progress

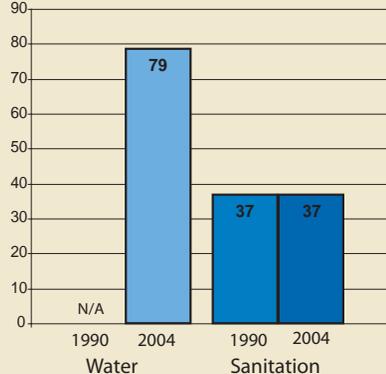
Protected area to total surface area, percentage



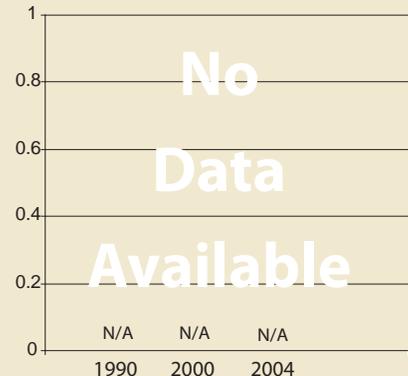
Land area covered by forest, percentage



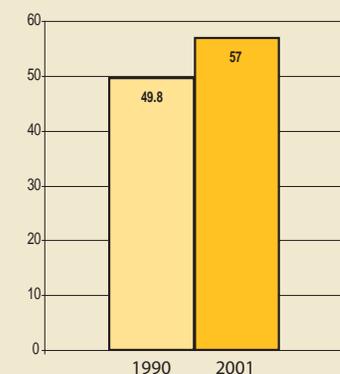
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



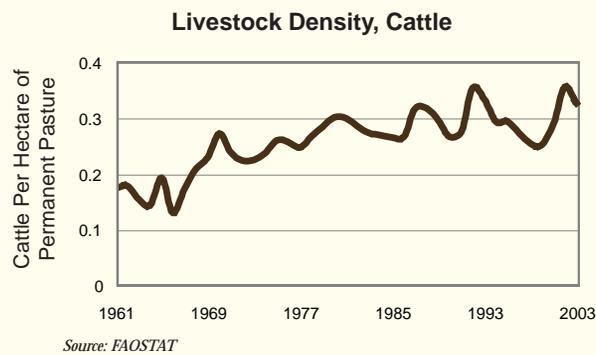
Slum population as percentage of urban



The Tlaeeng Pass, in the north of Lesotho, is 3 275 metres above sea level; it is the highest road in Africa.

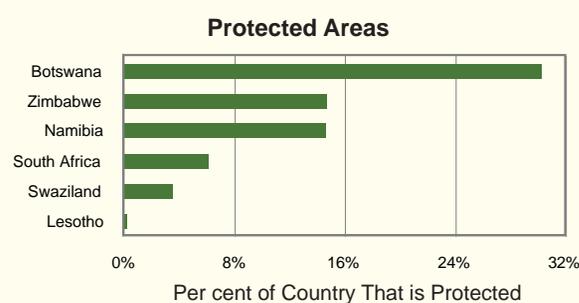
Degradation of Rangelands

Two-thirds of Lesotho is rangeland (FAO 2007), much of which is heavily overstocked and overgrazed. Most rangelands exist in the mountainous region, which is highly vulnerable to soil erosion due to shallow soils, sparse vegetation, and steep topography. Poor range management has led to severe land degradation, especially in times of drought that are followed by heavy rains. This degradation has particularly affected wetlands, which are important domestic water sources and provide essential habitat for many species.



Threats to Biodiversity in the Lesotho Highlands

Large mammals have been extirpated from Lesotho, but unique biodiversity can still be found throughout the country and particularly in the mountainous



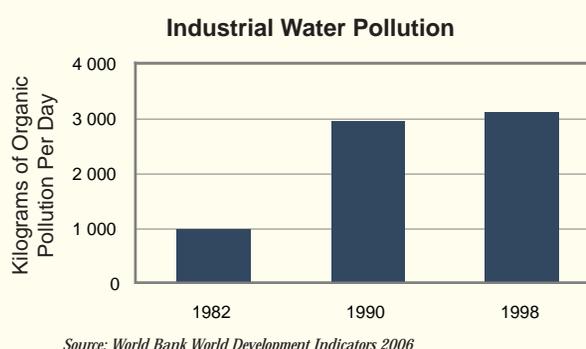
highlands. The Maloti and Drakensberg mountain ranges, 60 per cent of which lie in Lesotho, are a globally recognized biodiversity hotspot. Of the estimated 3 094 floral species found there, one-third are endemic to the region (Lesotho National Environment Secretariat 1998). These biological resources are being over-exploited by people seeking fuelwood or medicinal plants and animals. In addition, rangeland degradation is facilitating the replacement of native flora with invasive weed species. Less than one per cent of land in Lesotho is officially protected, which is the second lowest proportion in all of Africa (UN 2007).

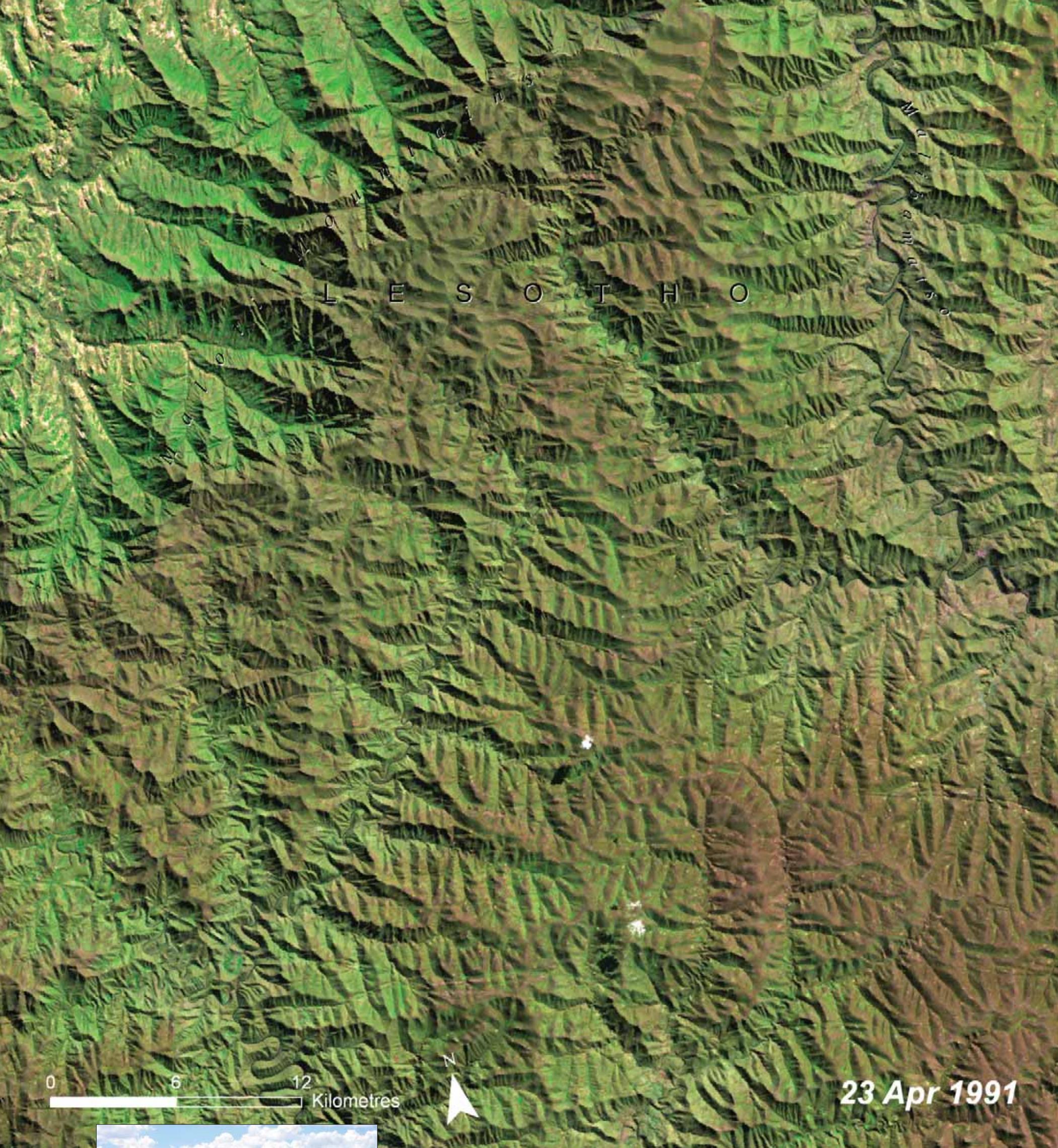
Water Resource Management and Pollution

The Katse Dam, a part of the Lesotho Highlands Water Project, submerged a number of valleys in the Maloti mountains, displacing many local communities and important habitat for several endangered species. However, the dam now generates valuable hydroelectric power, some of which is sold to the Republic of South Africa, creating important revenue for Lesotho.

The industrial sector is the largest water consumer in Lesotho, accounting for over half of all water use (FAO 2005). Pollution from the industries,

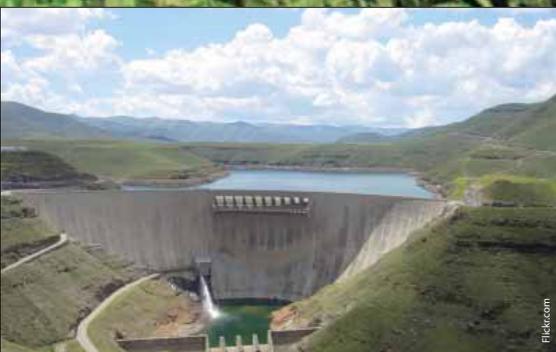
as well as from diamond mining activities, is known to contaminate surface water resources.

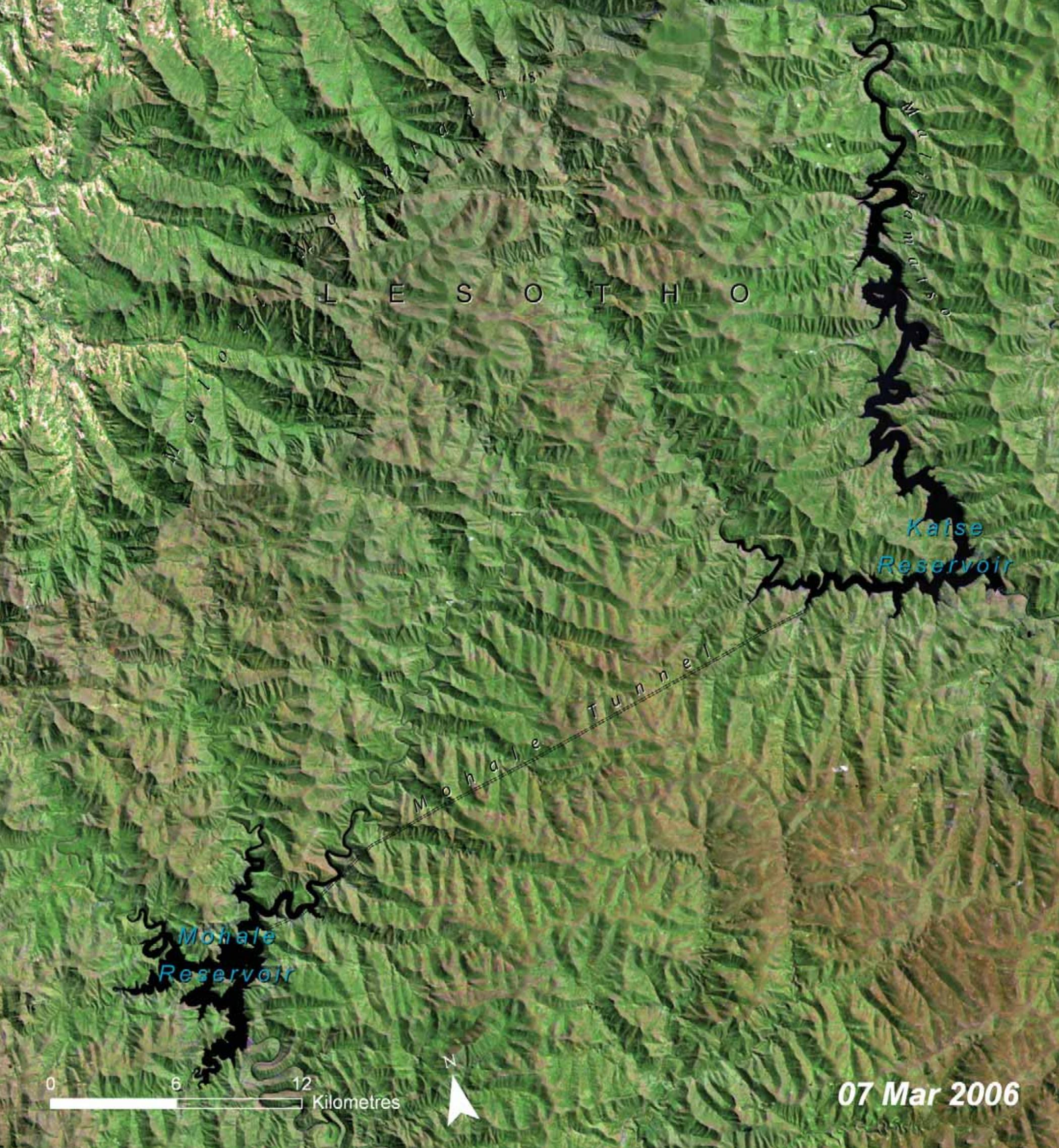




The Lesotho Highlands Water Project: Lesotho

In 1986, a treaty signed by South Africa and Lesotho initiated the Lesotho Highlands Water Project. The project design included a total of five dams, but committed the parties to only the first two dams and related infrastructure at a cost of over US\$1 400 million. The project's purpose was to deliver water to Gauteng Province in the industrial heartland of South Africa and hydroelectric power and income to Lesotho. In 1997, the 185-metre Katse Dam was completed on the Malibamatso River. The second phase of the project including the Mohale Dam was completed in 2003.





The Lesotho Highlands Water Project has been controversial since it began, with concerns about both social and environmental impacts. More than 20 000 people were affected by Katse Dam and 7 400 by Mohale, including loss of homes, farmland, and communal grazing land. The 1991 image shows part of the project area before the dams were constructed. The 2006 image shows the areas inundated after both dams were completed. The first two dams, Katse and Muela (not shown) took approximately 1 900 hectares of croplands and Mohale a further 1 000 hectares. Together, the three dams decreased pastureland by 5 000 hectares. In addition to the impact on the immediate area, approximately 150 000 people are affected by reduced stream flow below the dams.



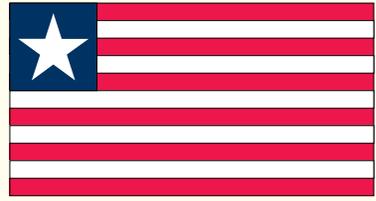


Republic of

Liberia

Total Surface Area: 111 369 km²

Estimated Population in 2006: 3 356 000



Liberia is a mostly flat and heavily forested country with low mountains rising to the northeast. The 560 kilometre-long coast is characterized by lagoons and mangroves and sustains 58 per cent of the population (National Biodiversity Strategy and Action Plan n.d.). Although the economy is heavily dependent on agriculture, minerals and forest products are the most valuable natural resources. Average annual rainfall ranges from 4 000 mm along the coastal belt to 1 300 mm at the forest-savannah boundary in the north.



Important Environmental Issues

- Deforestation and Rubber Plantations
- Threats to Biodiversity
- Water Pollution

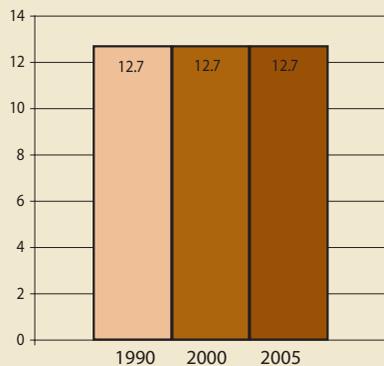
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

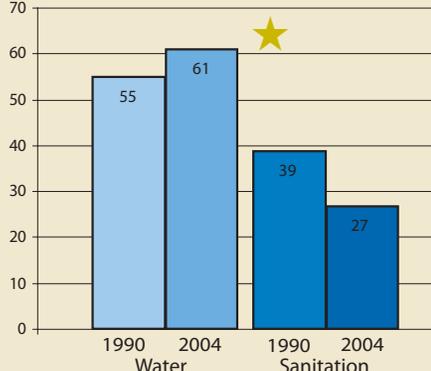
Liberia's biggest environmental challenge is the lack of proper sanitation, which has declined by 12 per cent in the MDG charts. With the population of over 3.3 million growing at a very fast rate, the problem of waste is particularly pressing. In the 1980s, Liberia had significant primary forest reserves, but recent estimates suggest that some 42 000 hectares of primary forest are converted annually to degraded forest or bushland.

★ Indicates progress

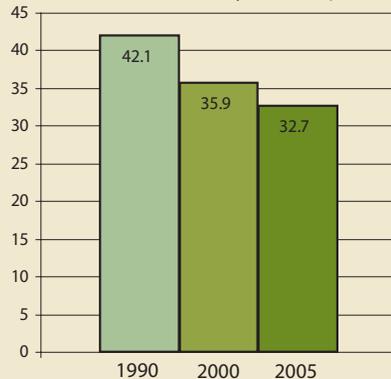
Protected area to total surface area, percentage



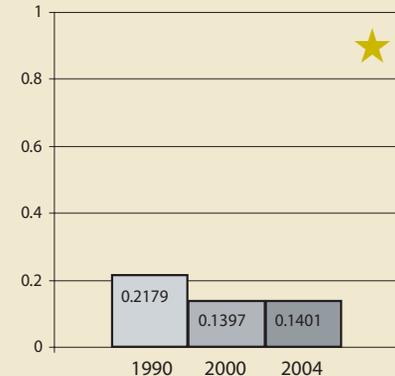
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



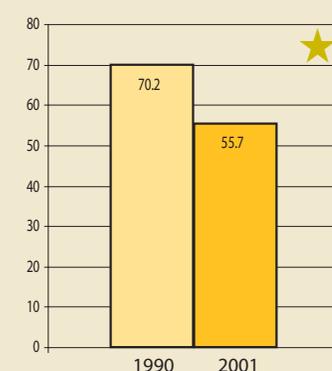
Land area covered by forest, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



Slum population as percentage of urban



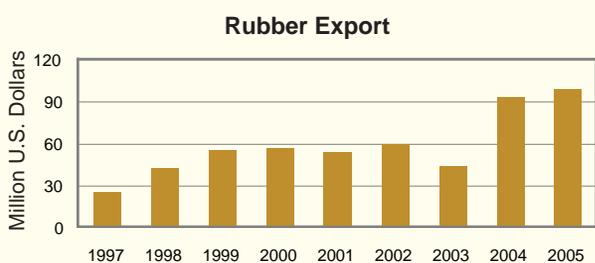
Monrovia, the capital city of Liberia, receives on average 5 140 mm of rain per year, making it one of the wettest inhabited places in the world.

Deforestation and Rubber Plantations

Liberia is thought to be the only country in West Africa that was once entirely covered by tropical rain forest (National Biodiversity Strategy and Action Plan n.d). Thanks to uncontrolled deforestation, forests now account for only one-third of land cover

and continue to disappear at a rate of roughly two per cent per year (UN 2007). Farmers cope with Liberia's generally poor soils by practising shifting cultivation, which is the major driver of forest loss. Logging, dependence on fuelwood, and rubber production are also factors.

Rubber is one of Liberia's top three export commodities. Rubber plantations, which are owned and operated by foreign business interests, have cleared more than 57 000 hectares of primary tropical forest and converted diverse forest ecosystems into single-species monocultures (National Biodiversity Strategy and Action Plan n.d).



Liberia's 2007 estimated annual population growth rate is the highest in the world at **4.8%**

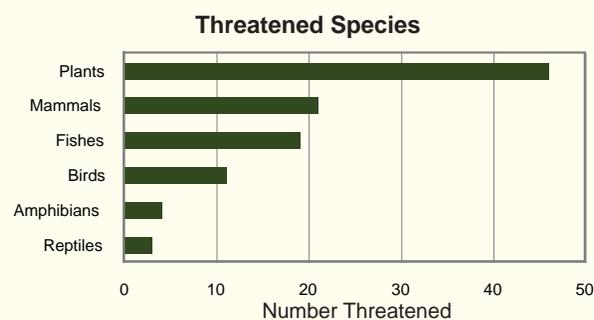
Flickr.com Fact: cia.gov (2008)

Threats to Biodiversity

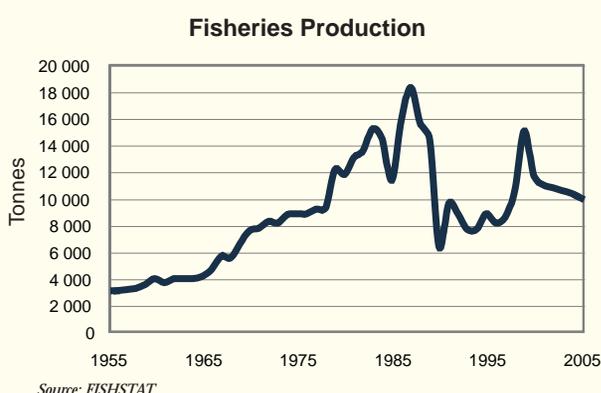
Liberia's forests are biologically rich, but species are threatened by habitat fragmentation and poaching. Wild animals are a major source of protein for most people since livestock production has been set back by prolonged civil war. Uncontrolled cutting of logging roads through virgin forests facilitates the bushmeat trade.

The Mount Nimba Nature Reserve, a UNESCO World Heritage Site, has exceptional species diversity due to the variety of habitats created by unique high altitude grasslands laced with montane forests. The area is still recovering from iron-ore mining activities

in the 1990s, which left over 300 million metric tonnes of mine wastes (UNEP 2004).



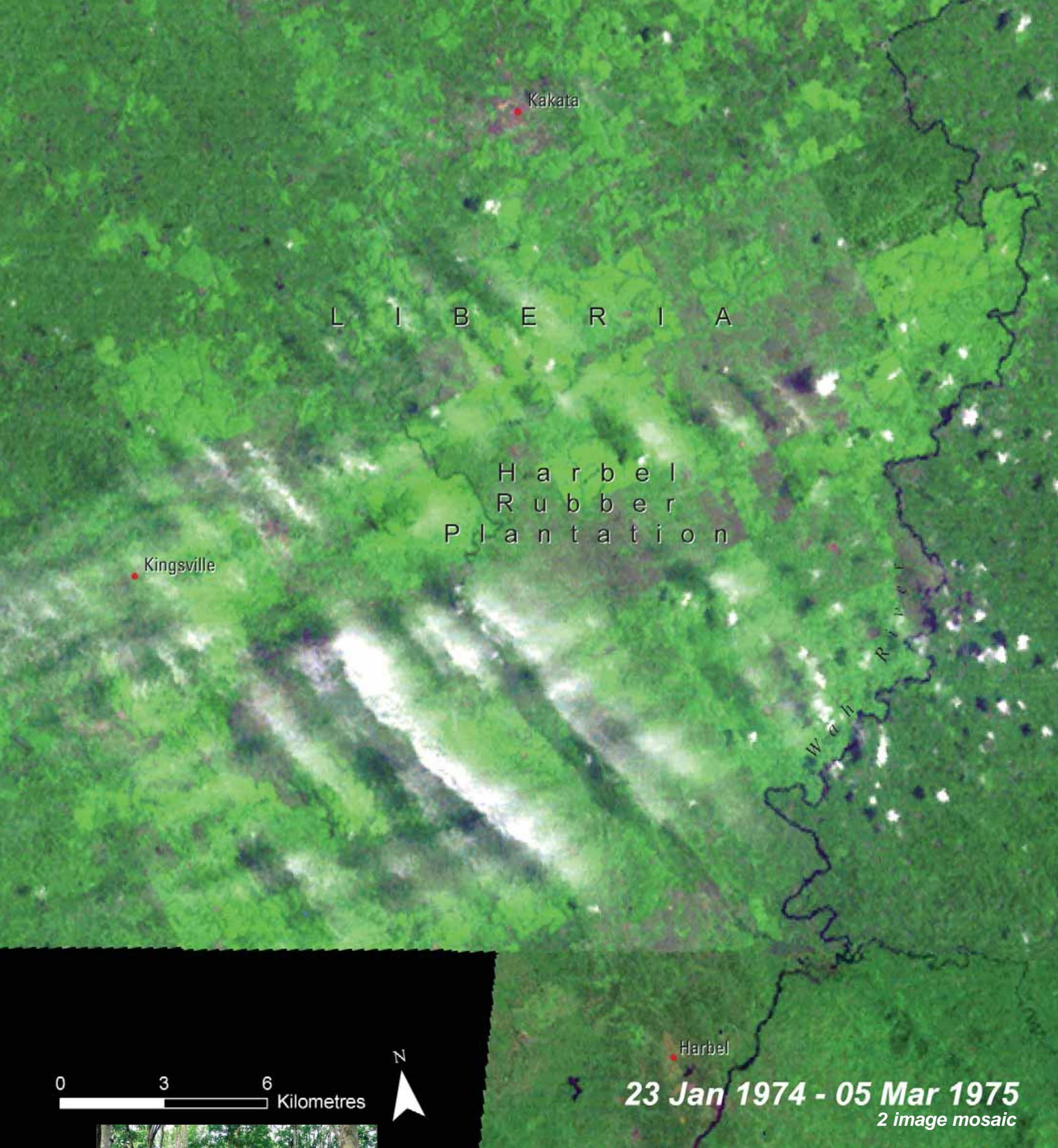
Water Pollution



Nearly 14 per cent of Liberia's surface is covered with water (National Biodiversity Strategy and Action Plan n.d.). After 14 years of civil war, waste collection services all but ceased, leaving raw sewage to pollute surface and groundwater. In addition, gold, iron, and diamond mines, the majority of which are unlicensed, discharge toxic metals and cyanide into rivers. Finally, leaking oil storage facilities are known to contaminate coastal waters. Water pollution is a threat to Liberia's fisheries, which provide over half of the population's protein intake and ten per cent of its gross domestic product.



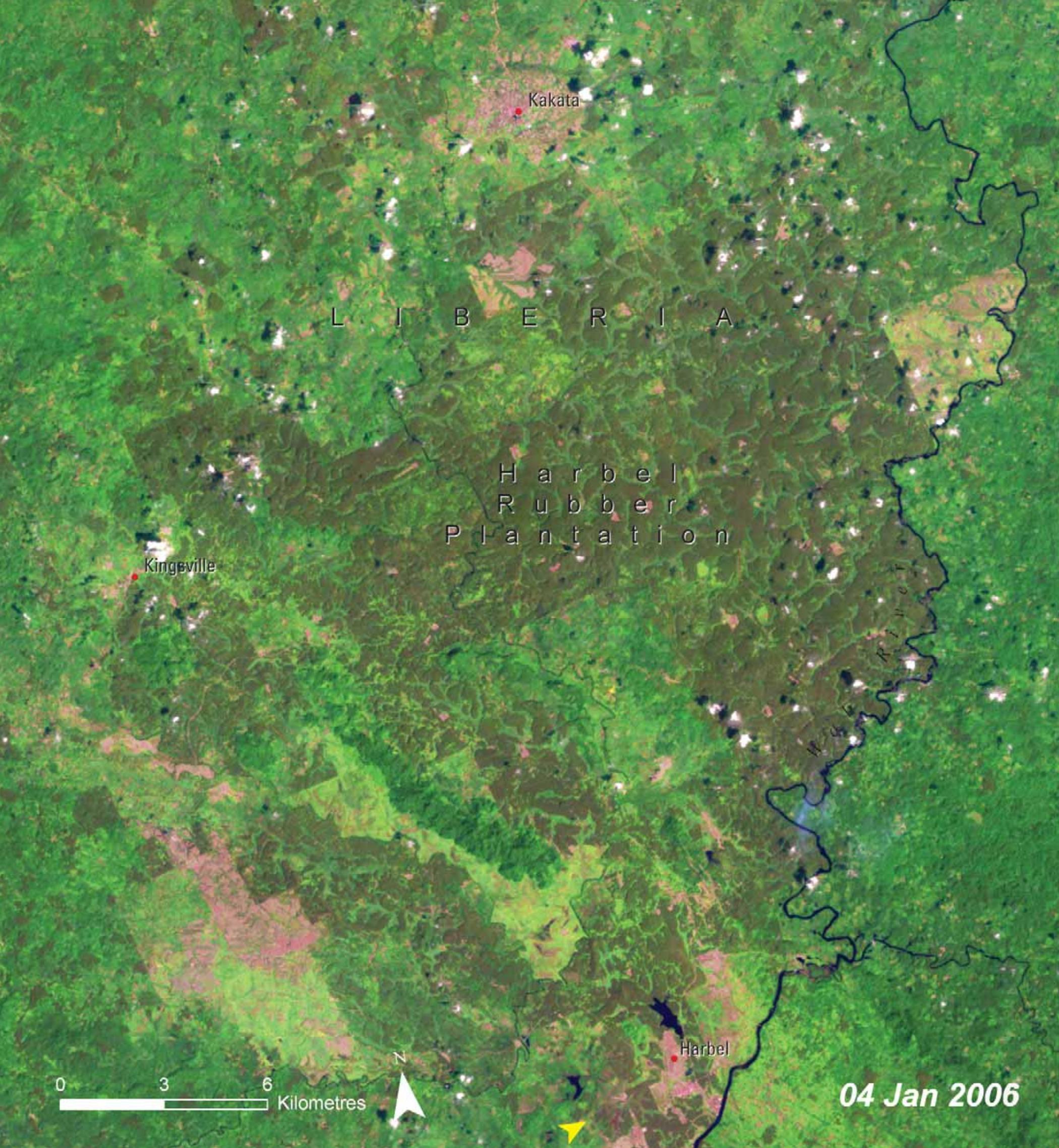
Flickr.com



The Harbel Rubber Plantation: Liberia

Built in the 1920s and 1930s, the Harbel rubber plantation just north of Monrovia, Liberia, is the largest in the world. This large monoculture plantation has created a host of environmental problems, including loss of biodiversity and the release of chemical waste into surface waters. Plantation workers are also exposed to compounds and chemicals that are internationally recognized as toxic and environmentally damaging.

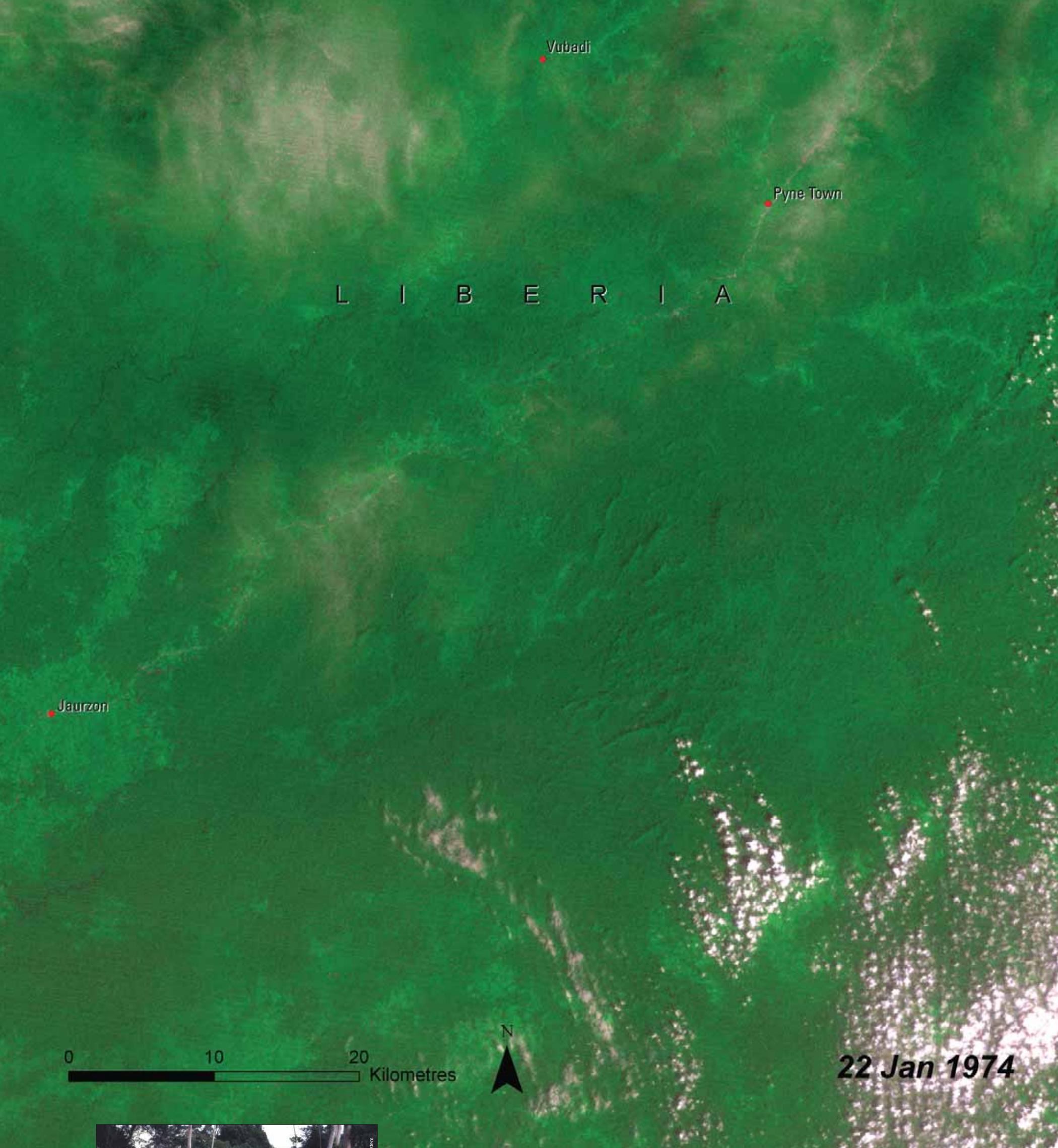
These two images show that the extent of the Harbel rubber plantation has expanded slightly in 30 years (yellow arrow). The change in colour of most of the plantation's vegetation may be



the result of seasonal variations—rubber trees drop their leaves at least once per year—or the age of the trees in the later image. Mature stands have more shadows and allow less of the leafy understory vegetation to show through than younger trees.

Most of the trees on Liberia's rubber plantations are nearing the end of their productive lifespan. This has brought the country's rubber industry to the brink of collapse. A new extension to the lease arrangement between Harbel's owners and the Liberian government was signed in 2005 which, according to the company, will allow for replanting to begin. However, it will likely take many years for the older trees to be replaced.

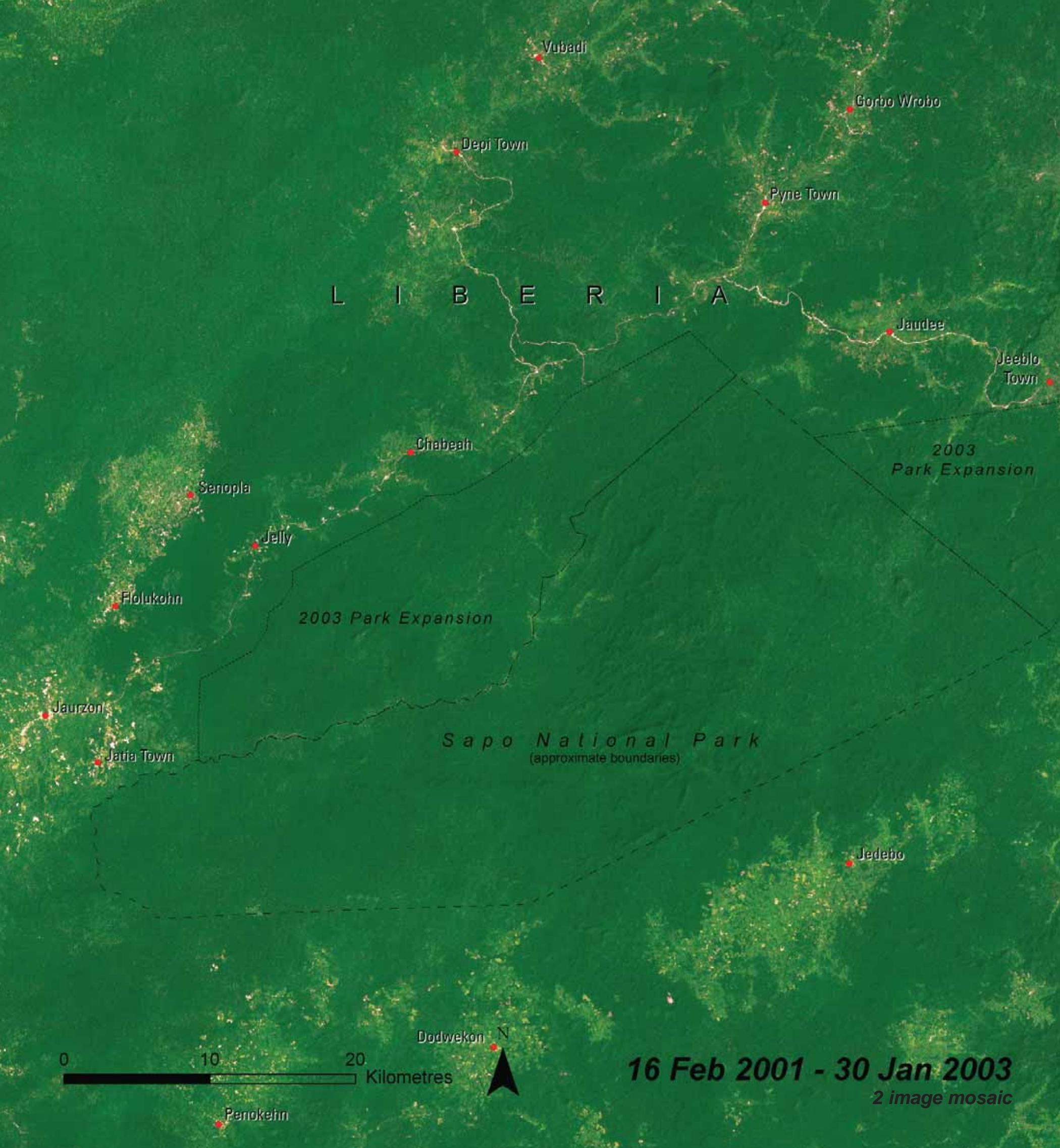




Joseph Laue / Board of Regents of the University of Wisconsin System

Indigenous Rain Forest: Sapo National Park, Liberia

Liberia's Sapo National Park is a largely undisturbed area (161 400 hectares) of lowland rain forest in the Upper Guinean Forest ecosystem. This ecosystem, which stretches from Cameroon to Guinea, has been decimated by logging, mining, and agriculture, leaving just three intact blocks, two of them in Liberia. Created in 1983, Sapo National Park was expanded by over 50 per cent in 2003. It is habitat for vulnerable and endangered species including the western chimpanzee, pigmy hippo, and forest elephant. The park's relatively pristine condition makes it an invaluable resource to Liberia and the world.



In the 25 years prior to Liberia's current government, the area of logging concessions granted totaled approximately 2.5 times the entire forested area of the country, with multiple concessions often overlapping one another. Concessions surrounded the area of Sapó National Park. Following a review of legality and status, all of the existing forest concessions were cancelled in February 2006. A year earlier, squatters who were illegally mining and poaching within Sapó were evicted.

The 1974 image shows the intact forest of the Sapó area prior to the park's creation. While roads and villages appear to have increased in the area surrounding the park, the 2001/2003 image shows that within the park itself, the forest remains in good condition.

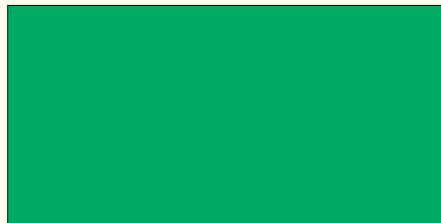




Socialist People's

Libyan Arab Jamahiriya

Total Surface Area: 1 759 540 km²
Estimated Population in 2006: 5 968 000



Libyan Arab Jamahiriya is a relatively large country with a long coast bordering the Mediterranean Sea. Roughly 95 per cent

of the country is desert, where rainfall is less than 100 mm per year. Although the average population density is one of the lowest in Africa, nearly three-quarters of the population is concentrated in coastal urban areas, which occupy only 1.5 per cent of the total land area (FAO 2005). Weather is influenced by the Mediterranean Sea to the north and the Sahara Desert to the south, creating an abrupt climatic transition.

Important Environmental Issues

- Water Scarcity
- Land Conversion and Desertification
- Oil Production and Pollution



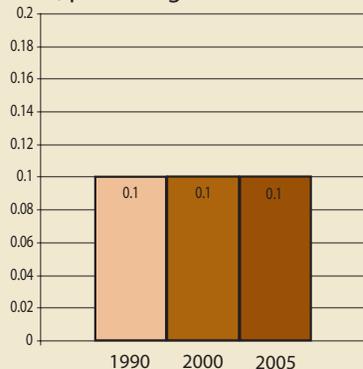
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

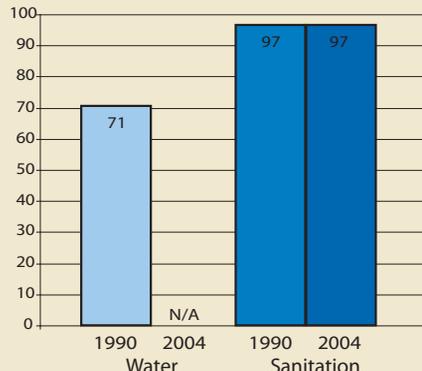
A major environmental concern in Libyan Arab Jamahiriya is the depletion of groundwater as a result of overuse in agriculture, causing salinisation due to sea-water penetration into the coastal aquifers. Eighty per cent of Libyan Arab Jamahiriya's agriculture is located in coastal areas.

★ Indicates progress

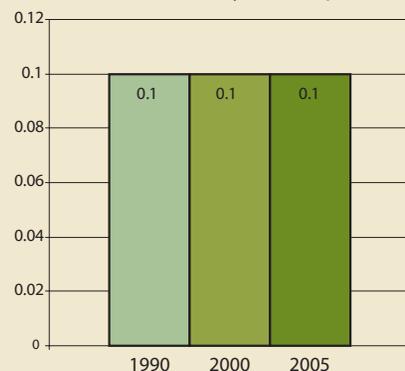
Protected area to total surface area, percentage



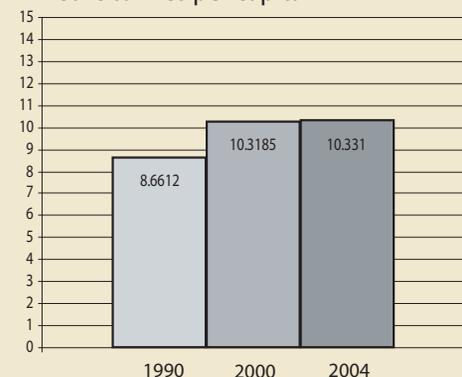
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



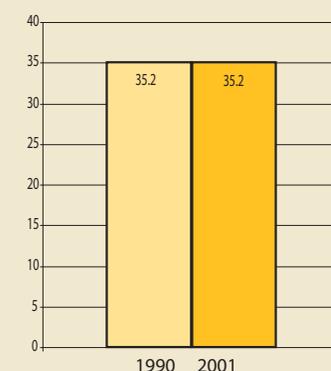
Land area covered by forest, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



Slum population as percentage of urban



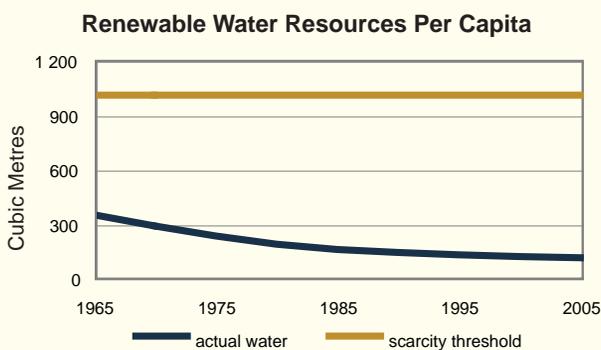
The Great Man-made River is the largest underground network of pipes in the world, supplying water from a fossil aquifer in Libyan Arab Jamahiriya's Sahara Desert to its coastal cities.

Water Scarcity

Libyan Arab Jamahiriya is the most water scarce country in Africa with only 104 m³ available per person per year (FAO 2007a). Where populations are concentrated near the coast, groundwater resources have been exploited beyond annual replenishment, resulting in a severe decline in the water table and saltwater intrusion (FAO 2005). Surface water resources are minimal and there are no perennial rivers.

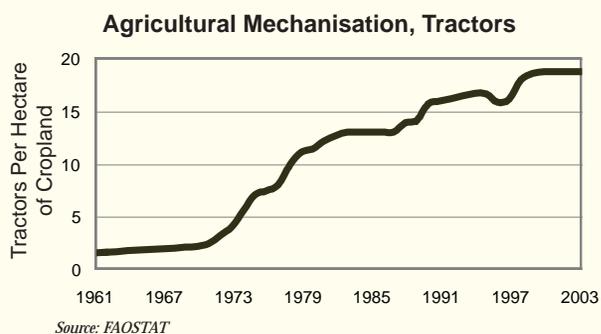
The Great Man-made River (GMMR) is an ongoing project since 1983, considered by some to be one of the greatest engineering feats in the world. The project involves the construction of 1 300 wells up to 500 m deep and 1 300 km of pipeline. Once completed, the GMMR will deliver 6.5 million cubic

metres of water per day from fossil aquifers in the desert south to the heavily populated northern coast (GMRA n.d.).



Land Conversion and Desertification

Just over one per cent of Libyan Arab Jamahiriya's land is considered to be arable, and virtually all of it is already being utilised. Furthermore, Libyan Arab Jamahiriya is the second most urbanised country in Africa. Continued urban expansion is anticipated to claim nearly half of the country's most fertile



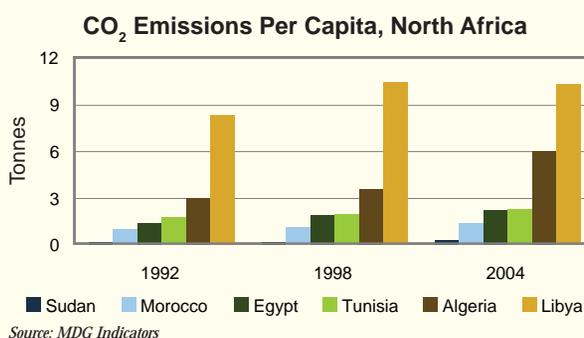
lands by 2025 (UNCCD 1999), to cope with limited availability of arable land. As a result agricultural production systems continue to increase in intensity. The number of sheep in Libyan Arab Jamahiriya, which are the primary livestock, has nearly quadrupled since the 1960s. The number of tractors used per hectare has multiplied in a similar fashion (FAO 2007b).

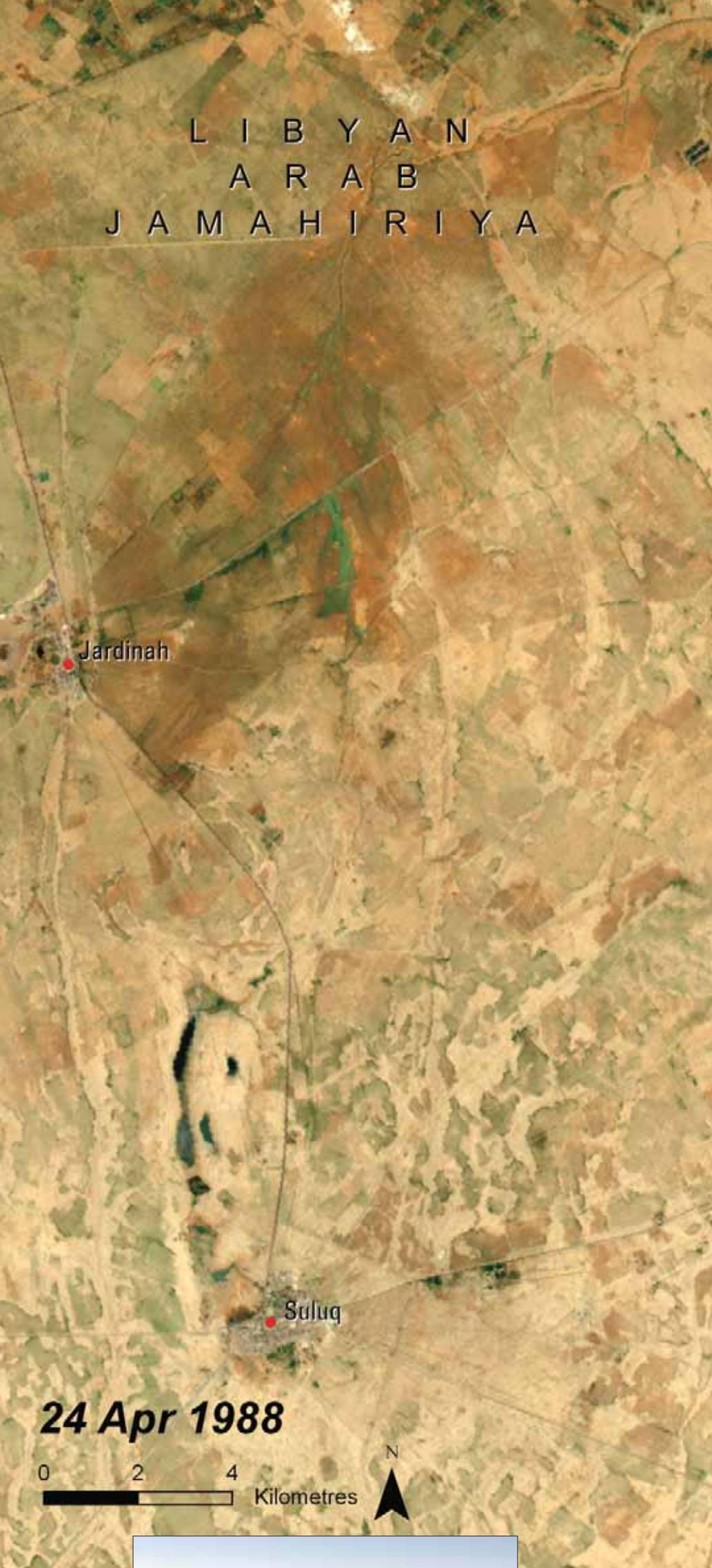
Due to agricultural intensity, a naturally arid climate, and lack of forest cover (only 0.1 per cent of land is forested), Libyan Arab Jamahiriya is at extremely high risk of desertification. The government has made significant investments to combat desertification in recent decades, including an afforestation initiative that involved some 2 500 km² of land (UNCCD 1999).

Oil Production and Pollution

Libyan Arab Jamahiriya currently is the site of over one-third of Africa's known oil reserves, yet the country is still considered largely unexplored, with great potential for new oil discoveries. The oil industry has been state-controlled since the 1970s, but is now seeking increased foreign investment to upgrade oil infrastructure and enhance production capacity (U.S. Department of Energy 2005). Although the majority of the country's oil is exported, domestic oil refineries contribute to higher per capita carbon dioxide emissions in Libyan Arab Jamahiriya than in any other North African country. Refineries also emit other forms

of air and water pollution that adversely impact surrounding communities and coastal environments.

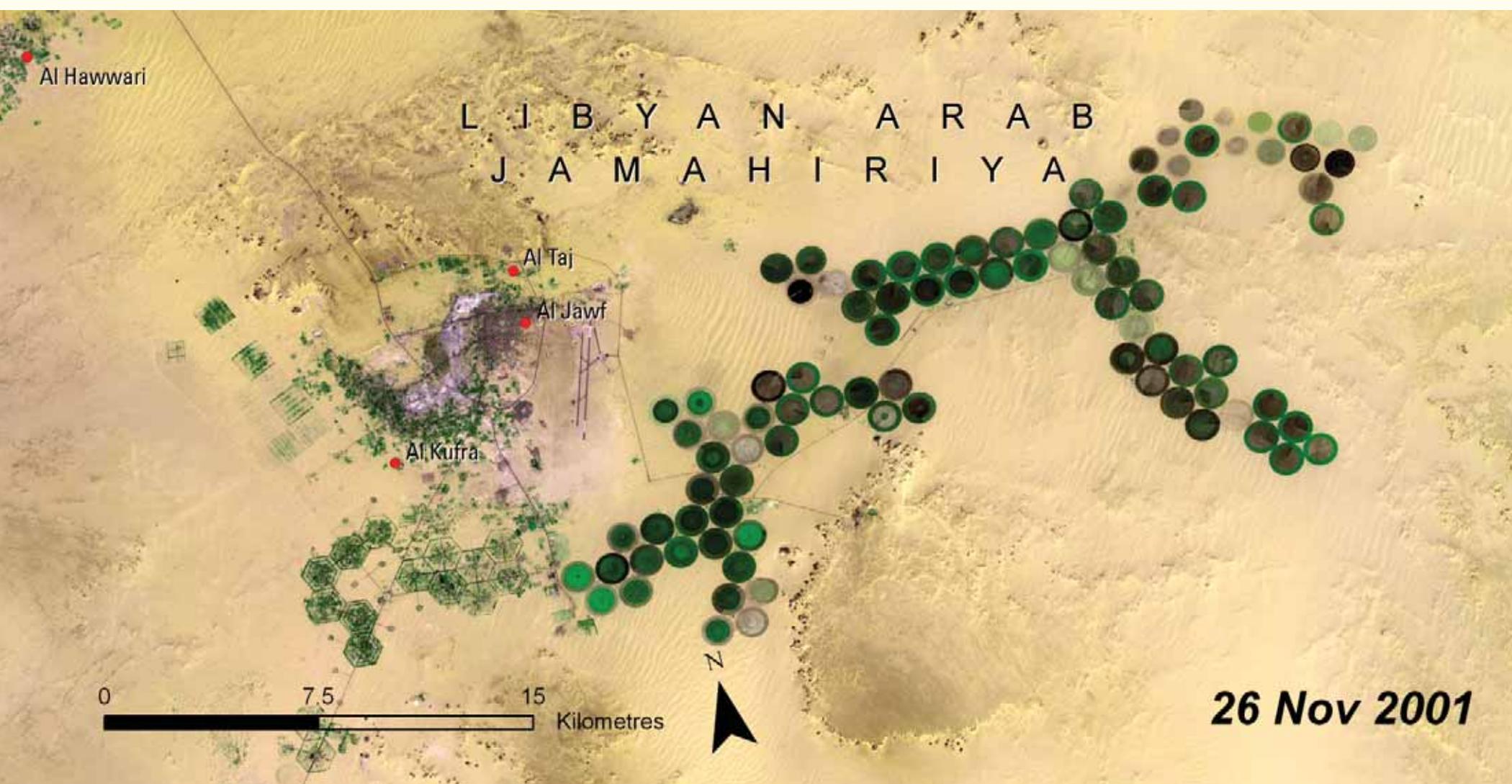
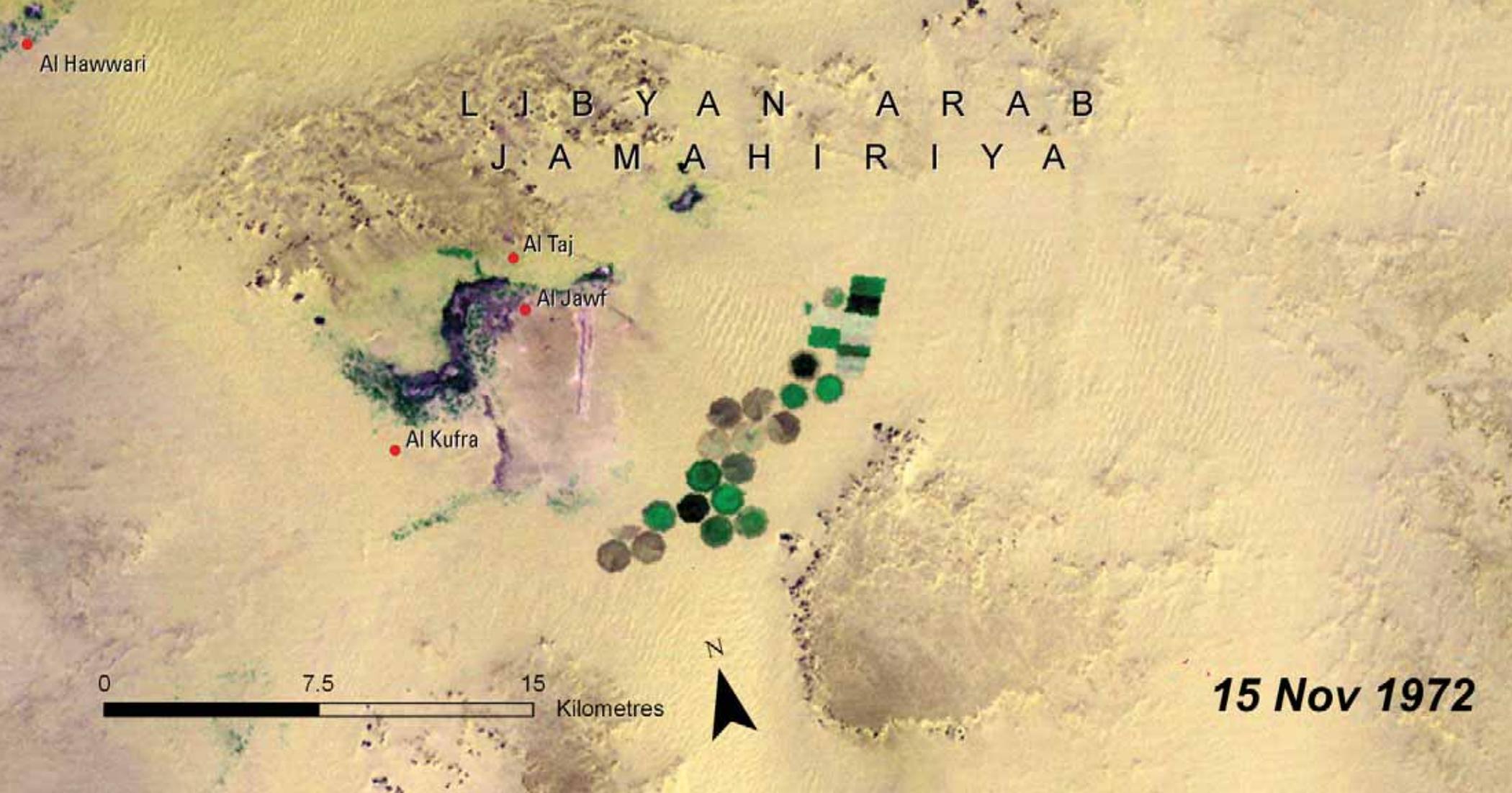




Great Man-made River Project: Libyan Arab Jamahiriya

In the 1950s, oil exploration in Libyan Arab Jamahiriya turned up another resource beneath the scorching sands: the Nubian Sandstone Aquifer System. Radiocarbon analysis showed that some of the water in the aquifer system was 40 000 years old. Tapping the aquifers was chosen as the most cost-effective option for meeting the country's water needs.

In 1993, Phase I of the Great Man-made River (GMMR) Project brought water from eastern well-fields at Sarir and Tazerbo to Benghazi (not shown). In 1996, Phase II brought water from well-fields



at Jebel Hassouna to Tripoli (not shown). Phase III is still under construction. The project's largest reservoir, known as the Grand Omar Mukhtar, is located at Suluq (2006 image, yellow arrows).

When fully operational, the GMMR will pump 3.6 million cubic metres of the Nubian Aquifer water per day. Water from the aquifer is used to support extensive centre-pivot irrigation agriculture at Al Kufra (see 1972 and 2001 images above).

At current extraction rates the Nubian Sandstone Aquifer System is not likely to be depleted for a thousand years. Nevertheless, it is shared among four African nations: Libyan Arab Jamahiriya, Chad, Sudan, and Egypt. The concern of environmentalists is that eventually people will drain the aquifer faster than nature can renew it. The International Atomic Energy Agency is trying to bring the four countries together to plan rational shared use of the water.



LIBYAN ARAB JAMAHIRIYA

*Mediterranean
Sea*

★ Tripoli
(Tarābulus)

0 5 10
Kilometres



29 Jan 1976



Urban Expansion: Tripoli, Libyan Arab Jamahiriya

Tripoli, the capital city of Libyan Arab Jamahiriya, is located on the country's Mediterranean coast along a narrow band of fertile lowlands that quickly give way to a vast interior of arid, rocky plains and seas of sand. Tripoli has undergone steady urban growth over the past thirty years. These satellite images, from 1976 and 2006, document some of the major changes in urban extent and the intensification of agriculture in the area surrounding the city.

LIBYAN ARAB JAMAHIRIYA

*Mediterranean
Sea*



Urban areas appear as shades of grey. Darker patches south of the city, visible in the 1976 image, represent grasslands that have since been converted to agricultural fields. Bright green areas are planted croplands. A few small areas of natural vegetation remain (yellow arrows).

Before the GMMR project began supplying water to the Tripoli area, the city's demands on the coastal Upper Aquifer were raising concerns of unsustainable use leading to salinisation of coastal water resources. The GMMR project began supplying water to Tripoli in August 1996 and is continuing to expand its delivery across the country's coastal area.



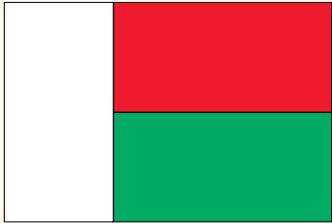


Republic of

Madagascar

Total Surface Area: 587 041 km²

Estimated Population in 2006: 19 105 000



Madagascar is one of the largest and oldest islands in the world, sometimes referred to as the "Great Red Island" because of its reddish soils. A high central plateau runs from north to south, separating the drier western lands from the tropical rain forests of the eastern coast. An average of 1 513 mm of rain falls per year, although significant regional disparities mean that some parts of the island suffer from chronic water shortages.

to south, separating the drier western lands from the tropical rain forests of the eastern coast. An average of 1 513 mm of rain falls per year, although significant regional disparities mean that some parts of the island suffer from chronic water shortages.

Important Environmental Issues

- Soil Erosion
- Endemism and Threats to Biodiversity
- Deforestation



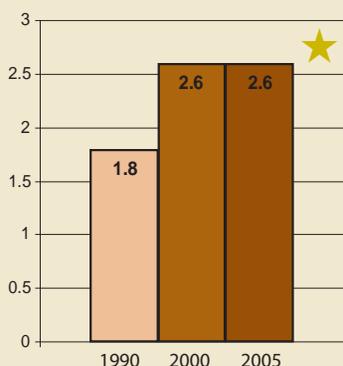
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

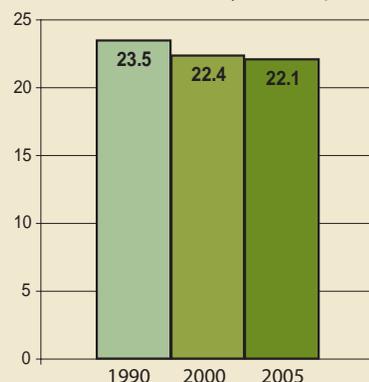
Madagascar is the world's fourth-largest island. Erosion, caused by deforestation and overgrazing, is a serious problem. Every year as much as a third of Madagascar burns. Fires set to clear land and revitalize pastures often spread into adjacent wildlands, causing damage to the island's unique ecosystems. Roughly 70 per cent of Madagascar's estimated 250 000 species are endemic. Between 1990 and 2004, Madagascar registered a marked increase in access to sustainable water source and sanitation.

★ Indicates progress

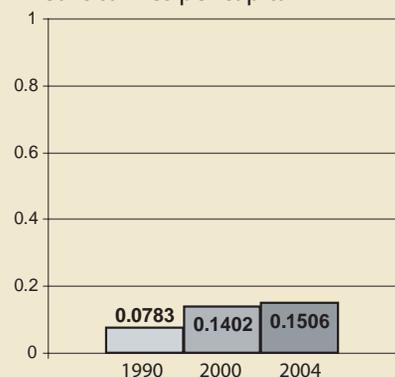
Protected area to total surface area, percentage



Land area covered by forest, percentage



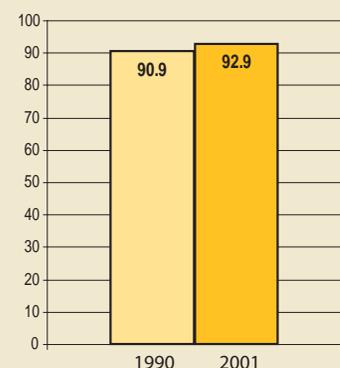
Carbon dioxide (CO₂) emissions, metric tonnes per capita



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



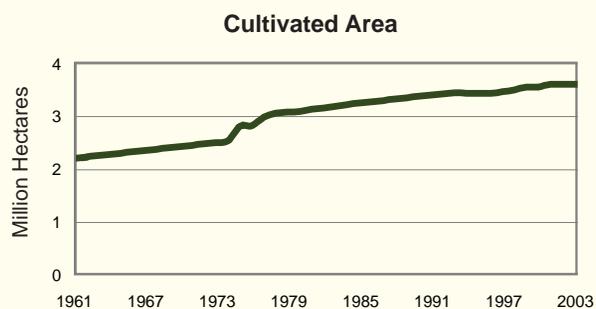
Slum population as percentage of urban



An astonishing 98 per cent of Madagascar's land mammals, 92 per cent of its reptiles, 68 per cent of its plants, and 41 per cent of its breeding bird species exist nowhere else on Earth.

Soil Erosion

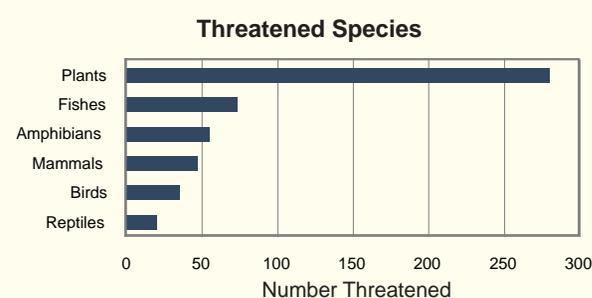
Madagascar experiences some of the worst soil erosion in the world, with nearly three-quarters of its land classified as severely degraded (FAO AGL 2003). Estimated annual soil loss ranges between 200 to 400 metric tonnes per hectare, which is approximately 20 to 40 times the global average (Rasambainarivo and Ranivoarivelo 2003). This is largely a result of frequent torrential rainfall, deforestation, and overgrazing on Madagascar's naturally steep and erosion-prone slopes.



Source: FAOSTAT

Endemism and Threats to Biodiversity

Geographically and biologically isolated for millions of years, Madagascar is home to a vast array of plants and animals found nowhere else in the world, including an estimated 102 endemic mammals, 202 endemic amphibians, 111 endemic birds, 332



Source: IUCN Red List

endemic reptiles, and approximately 6 500 endemic vascular plants (UNEP-WCMC 2004). However, habitat destruction from expanded agriculture and increased deforestation threatens this biodiversity. Madagascar has more endangered species than any other country in Africa (IUCN-SSC 2007).

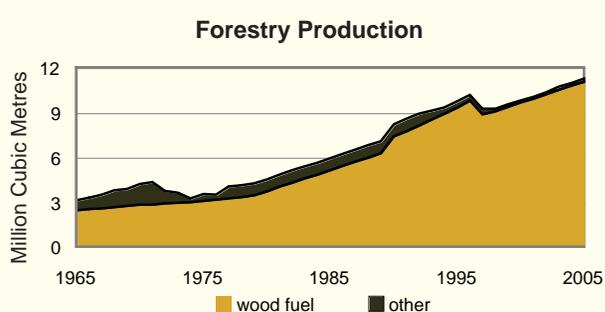
Unique to Madagascar, lemurs are a group of primates that evolved after Madagascar split from the rest of the African continent roughly 150 million years ago. Of the island's 32 species of lemurs, a number are already extinct. Lemur species are quite diverse, ranging from the 2.5-kg ring-tailed lemur to the pygmy mouse lemur, which at 85 grams is the world's smallest primate.



Flickr.com Fact: biodiversityhotspots.org (2007)

Deforestation

Forests once covered nearly all of Madagascar, but less than one-quarter of the island's original forest extent remains today (UN 2007). Rising fuelwood



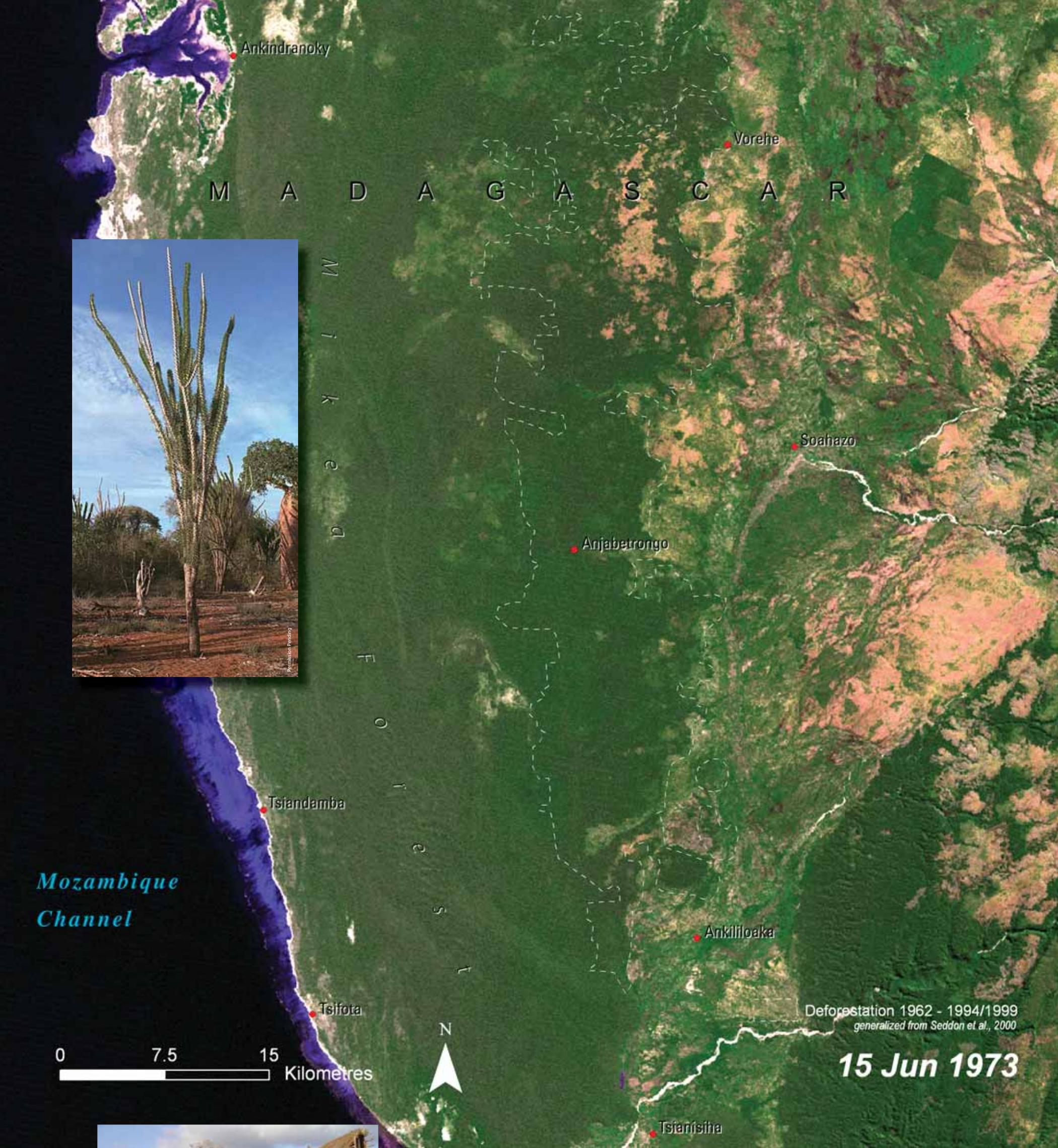
Source: FAOSTAT

consumption, expanded agricultural activities, and logging are the major drivers. In addition, wildfires destroyed approximately 3.74 million hectares of forest between 1997 and 2000 alone (FAO 2005).

Madagascar has over 300 000 hectares of mangroves, the vast majority of which are found on the western coast (Wilkie and Fortuna 2003). Coral reefs lie offshore from mangroves in many places. The reefs protect the mangroves from ocean swells, while the mangroves in turn catch sediment runoff that can damage the reefs. Mangrove ecosystems are in danger from urban development, over fishing, erosion, and aquaculture.



Flickr.com



Permission Pending

Mozambique Channel

Deforestation 1962 - 1994/1999
generalized from Seddon et al., 2000

15 Jun 1973



Photos by John W. M. M. Seddon

Deforestation in Mikea Forest: Madagascar

On an island known for endemic species, the South Malagasy spiny forests in the southwestern corner of Madagascar are one of the islands most distinct ecosystems. Within Mikea Forest, the unusual *Didierea madagascariensis* (see photo) and *Euphorbia stenoclada* as well as the more common *Adansonia fony* are among the most widespread tree species. Mikea Forest is also home to many endemic reptile and bird species. Two bird species unique to the Mikea Forest, the subdesert mesite (*Monias benschi*) and the long-tailed ground-roller (*Uratelornis chimaera*), are classified as vulnerable.

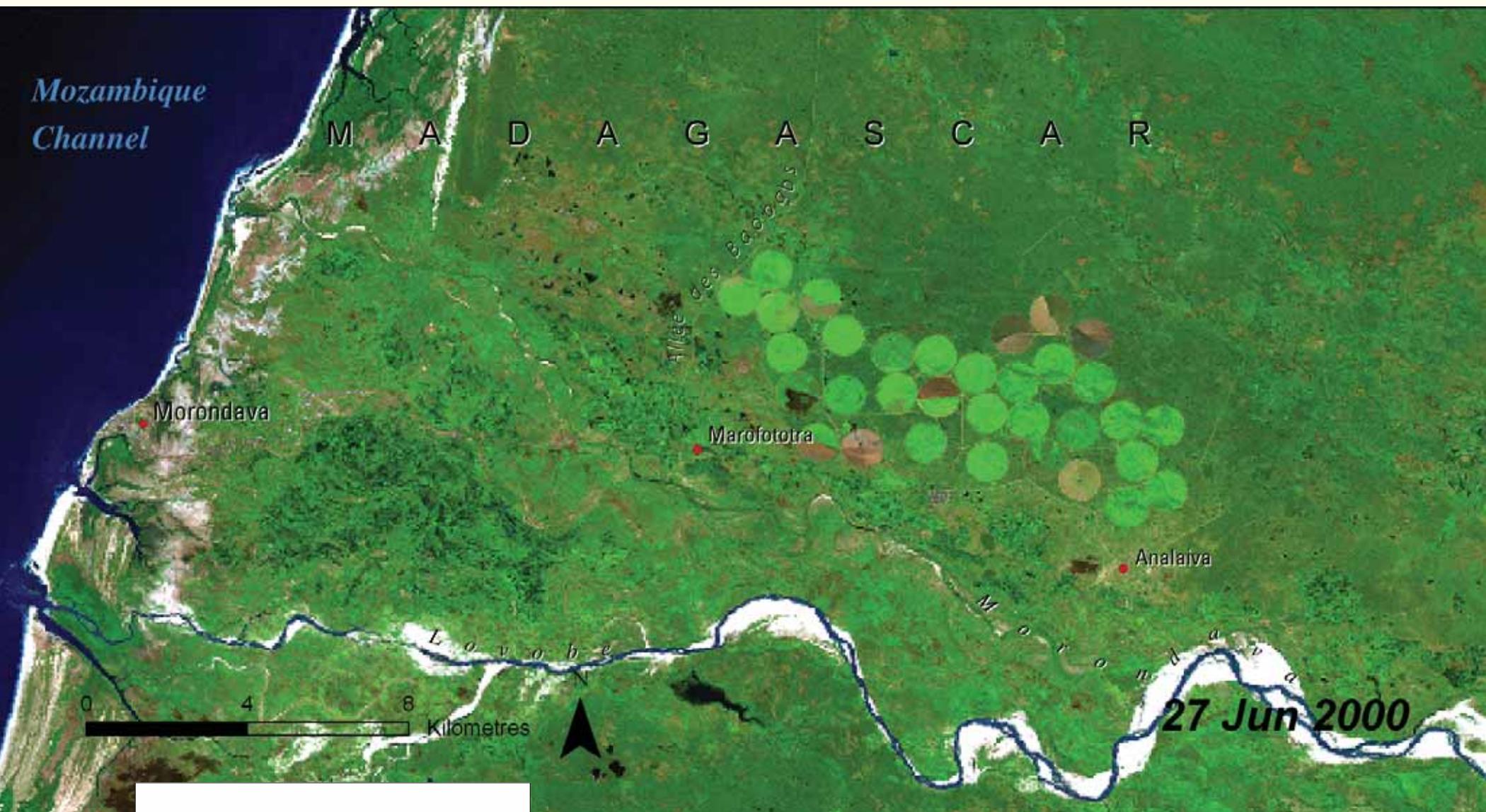


The village of Anjabetrongo, in the center of the two satellite images, is surrounded by trees in the 1973 image and by cropland in the 2002/03 image. This recent aerial photo of the village shows tall baobabs scattered across the landscape of brush and croplands.

The area of Mikea Forest shown in these images has lost approximately 28 per cent of its primary forest cover in the last three decades and the rate of loss appears to be accelerating. The white dashed line shows loss between 1962 and 1999. The 2002/2003 image shows deforestation advancing still further to the west.

A large portion of the forest has been lost to charcoal production, most of it for commercial sale in Toliara. This is especially true at the southern edge of the forest where road accessibility is greatest. Further north, slash-and-burn maize cultivation is practiced by the Mikea people native to the area. Most of this maize is for local consumption. This appears to be the driving force of forest loss along the eastern edge of the forest, which has moved almost 10 km to the west since 1973.





Centre Pivot Irrigation: Morondava, Madagascar

The large circular fields of irrigated sugarcane near Morondava in western Madagascar are an anomalous sight in this area more known for its baobab trees. While the average temperature in the area is ideal for sugarcane cultivation, a long dry season (April to November) makes irrigation necessary. These three images show the region before irrigation (1973), after irrigation was introduced (2000), and after further expanded irrigation (2006). Managed by a foreign company, most sugar cane grown in the area is exported. Ironically, sugar must be imported for the local market. Roughly 22 000 metric tonnes of sugar were produced here in 2006.



Mozambique
Channel

M A D A G A S C A R

Marofandilia

Andriamena

Morondava

Marofototra

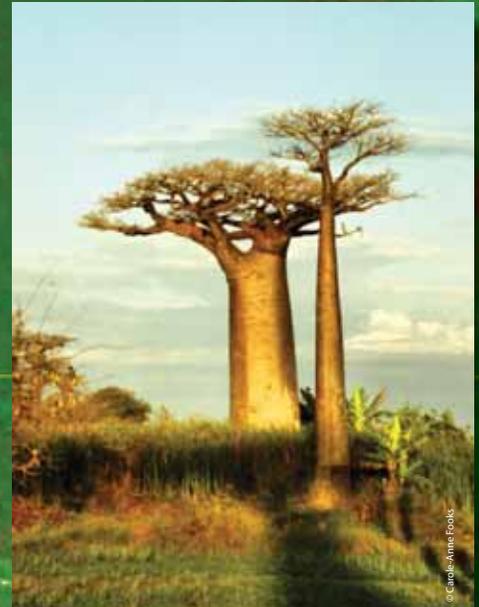
Analaiva

Allée des Baobabs

0 4 8
Kilometres



12 Jun 2006



Baobab trees growing among the sugar cane fields are surrounded by rice paddies.

Baobabs, sometimes called “upside down trees” can live for up to 5 000 years. While there is only one baobab species on the African continent, Madagascar is home to seven different species. The volume of water needed for irrigating sugar cane fields may threaten the survival of these ancient trees if sugar cane farming extends into baobab areas—particularly the “allée des Baobabs” (Baobabs Boulevard, yellow arrows). Baobabs are also under threat by local community rice farming. Since August 2007 the “allée des Baobabs” has been temporarily classified as a protected area, the result of consultation between local communities, local authorities, and government authorities.





Republic of

Malawi

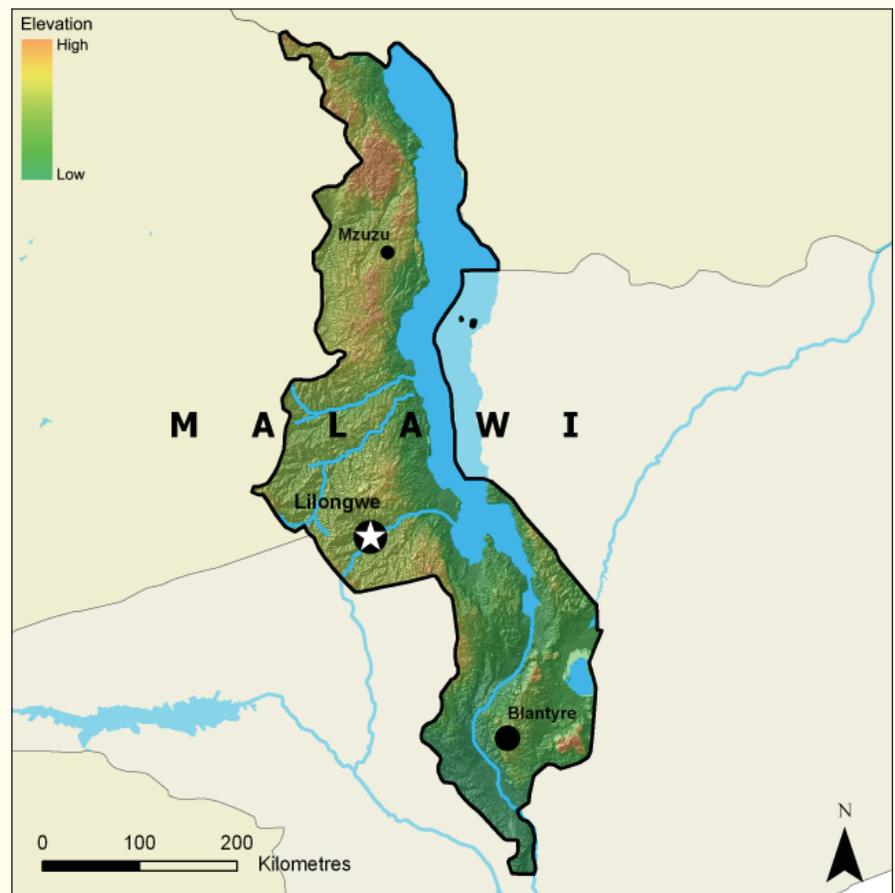
Total Surface Area: 118 484 km²

Estimated Population in 2006: 13 166 000



Malawi is a small and densely populated country characterized by extremely diverse physical features, which support a wide variety of plant and animal life. The climate varies from semi-

arid to sub-humid and is strongly influenced by the presence of Lake Malawi (Nyasa), which spans almost two-thirds of the nation's eastern border and is the third largest lake in Africa (FAO 2005). Including Lake Malawi (Nyasa), surface water covers one-fifth of the total country area.



Important Environmental Issues

- Land Scarcity and Soil Erosion
- Deforestation for Fuelwood
- Water Pollution and Aquatic Biodiversity

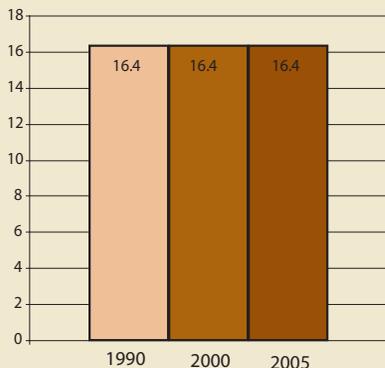
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

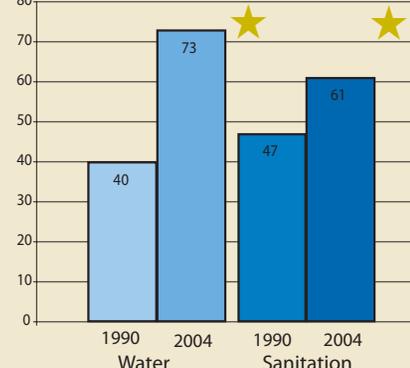
Deforestation is a serious problem in Malawi. Between 1990 and 2005, the country lost nearly 13 per cent of its total forest cover due to fuelwood collection and subsistence and commercial agriculture; tobacco farming accounts for nearly 80 per cent of the nation's export earnings. About 21 per cent of Malawi's total land area is arable. Malawi is self-sufficient in food production, except during droughts.

★ Indicates progress

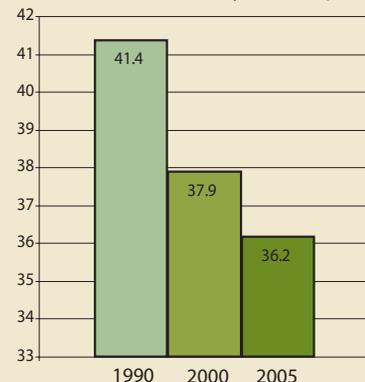
Protected area to total surface area, percentage



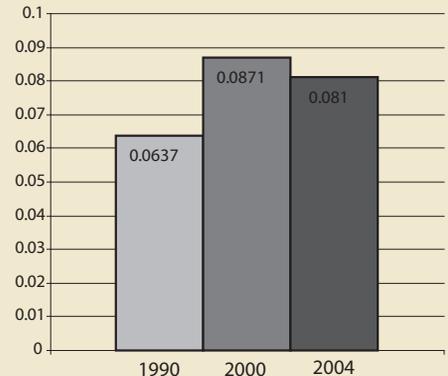
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



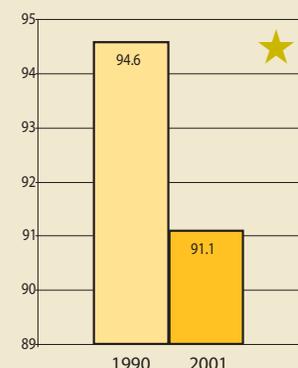
Land area covered by forest, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



Slum population as percentage of urban

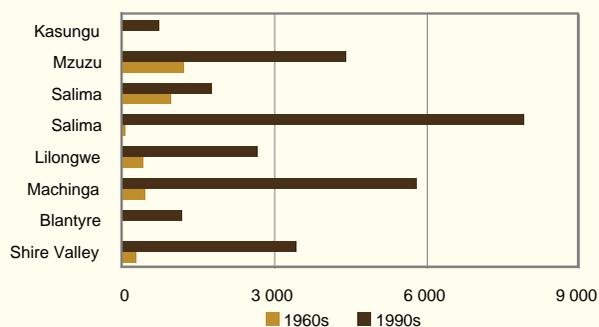


With over 1 000 species, many of them endemic, Lake Malawi (Nyasa) is home to the largest variety of fish of any lake in the world.

Land Scarcity and Soil Erosion

Arable land is Malawi's most valuable natural resource and agriculture is vital to local livelihoods and the national economy. Cultivated area has more than doubled since 1961 (FAO 2007a) to accommodate rapid population growth, resulting in a growing land shortage. In 2002, an estimated 16 per cent of cultivation was taking place on marginal or unsuitable lands (SoE 2002). As a result, widespread soil erosion is sapping soil fertility and causing siltation of lakes and rivers, including the Shire River, which is the major outlet of Lake Malawi (Nyasa) and is important for hydroelectric power generation.

Farmers Per Agricultural District



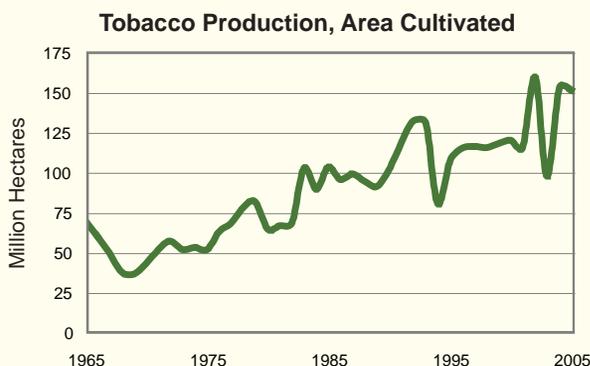
Source: Rwanda State of the Environment Report 2002



83% of Malawi's population is rural

Flickr.com Fact:unstatsun.org (2006)

Deforestation for Fuelwood



Source: FAOSTAT

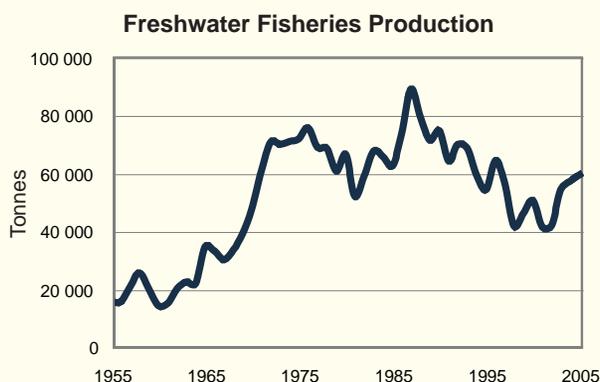
Deforestation, driven significantly by fuelwood harvesting and tobacco production, is also contributing to the rapid degradation of Malawi's intensively used lands. Malawi is the second largest tobacco producer in Africa after Zimbabwe (FAO 2005). Harvesting wood to fuel the tobacco-curing process accounts for roughly one-quarter of household wood consumption (Poitras 1999). Overall, it is estimated that demand for wood exceeds supply by 30 per cent (SoE 2002). The rising price of alternative energy sources, such as oil, has actually increased reliance on fuelwood in recent years to over 90 per cent of energy use (FAO 2003).

Water Pollution and Aquatic Biodiversity

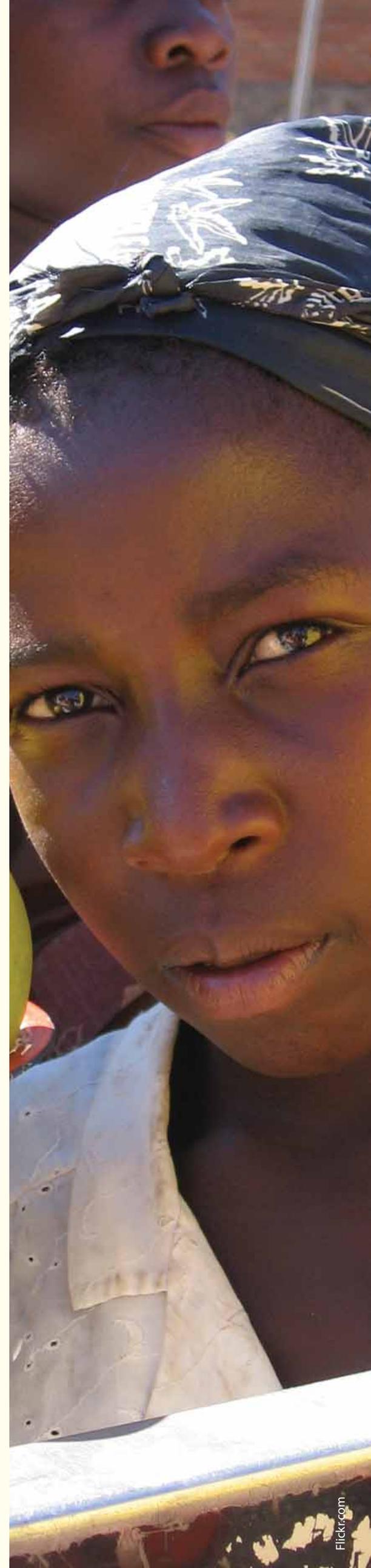
The annual internal surface water production for Malawi was 16.14 km³ in 2007. In spite of this, Malawi is classified as a water stressed nation, since only 1 374 m³ of water is available per person annually (FAO 2007b). Siltation from soil erosion and pollution from agricultural runoff and sewage are major threats to Malawi's surface water resources. Three-quarters of all rivers are significantly polluted by human waste (SoE 2002).

Water pollution affects Malawi's unique aquatic resources, which include over 1 000 fish species, accounting for nearly 15 per cent of global freshwater fish biodiversity. Lake Malawi (Nyasa) in particular contains more unique fish species than any other lake in the world, over 90 per cent of which are endemic (CBD 2007). There is evidence

of localized overfishing in Lake Malawi's (Nyasa's) inshore waters, although offshore resources are thought to be underexploited due to lack of appropriate fishing gear.



Source: FISHSSTAT



Flickr.com



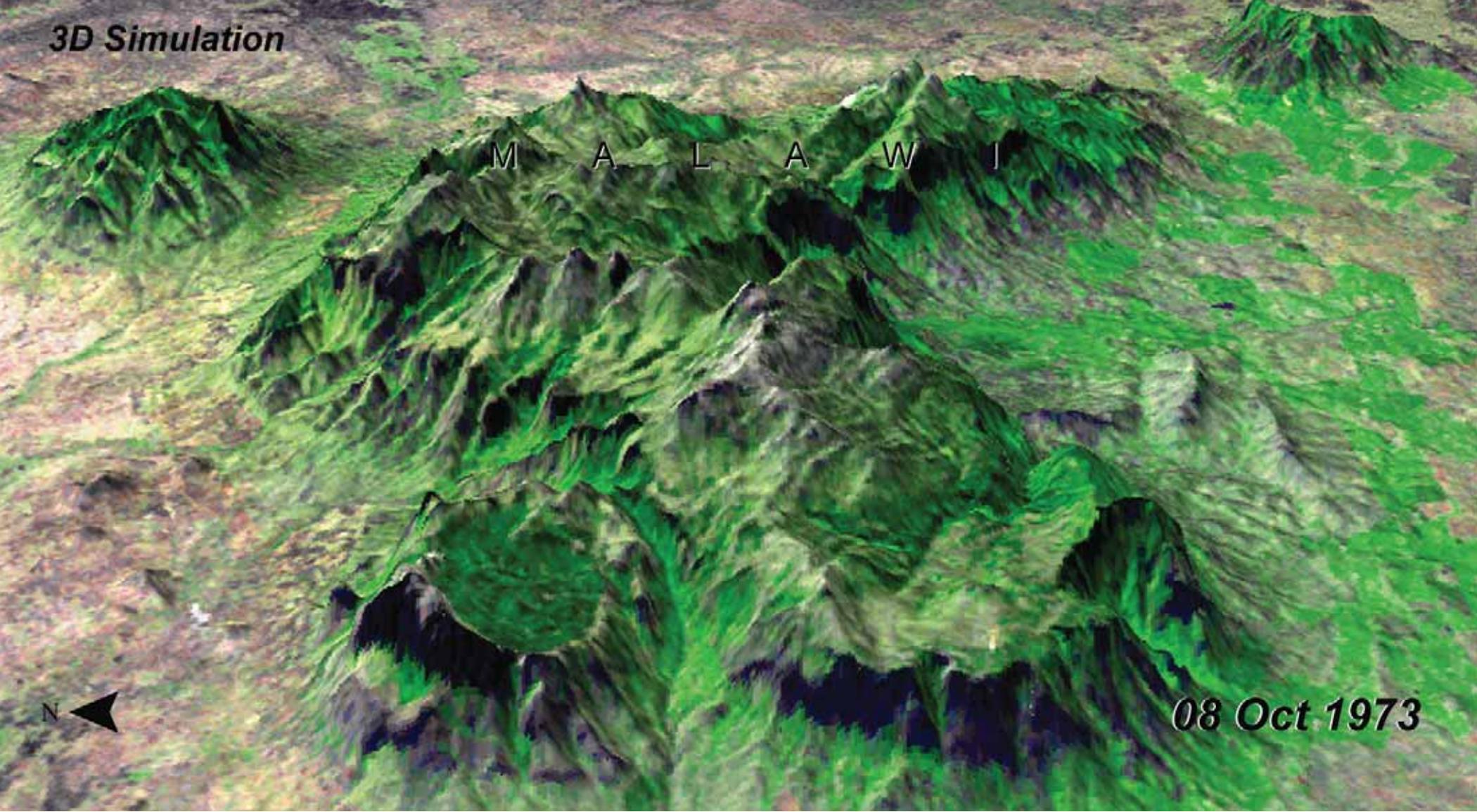
Algae Blooms: Lake Malawi (Nyasa), Malawi

Lake Malawi (Nyasa), the third-largest lake in Africa, is an essential water resource for Malawi, Mozambique, and United Republic of Tanzania. A 2003 study indicated that sediments and nutrients from densely settled areas surrounding Lake Malawi (Nyasa) are entering lake waters, increasing nutrient loading by as much as 50 per cent.

In these images, the bluish green swirls in the lake are algae blooms caused by these excess nutrients. Among other things, the algae reduce dissolved oxygen levels in the water. This poses a threat to the lake's fish species. The algae blooms appear worse in 2006 (note their concentration along the lake's western shore, yellow arrow), suggesting that water quality may be continuing to decline.



3D Simulation



3D Simulation



Mountain Deforestation: Mount Mulanje, Malawi

Rising to 3 000 metres, Mount Mulanje is the tallest peak in south-central Africa. It is an important source of water for almost every river that runs through southern Malawi. Mulanje Mountain Forest Reserve was created in 1927, primarily to safeguard the water catchments and to control the extraction of the endemic Mulanje cedar—Malawi's national tree.

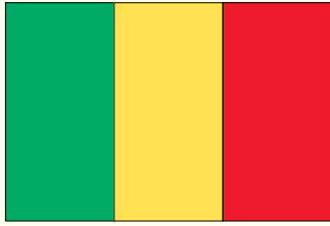
Forest cover in and around the park is threatened by agricultural conversion, wildfires, fuelwood collection, and invasive species. Between 1973 and 2006, the top of the mountain underwent notable deforestation (yellow arrow).





Republic of Mali

Total Surface Area: 1 240 192 km²
Estimated Population in 2006: 13 918 000



Mali is a large landlocked country stretching from the Sahara Desert in the north to the Niger and Senegal River Basins in the centre and south. Average rainfall is low, at only

280 mm per year, although there is a strong north-south gradient. As a result, the majority of economic activity, food production, and human settlement is concentrated in the more hospitable riverine areas of southern Mali. Between the cities of Tombouctou and Bamako, the Niger River forms a large inland delta, a unique geographical formation of streams, marshes, and lakes that provide important habitat for many plant and animal species.

Important Environmental Issues

- Desertification and Drought
- Water Availability and Pollution
- Threats to Biodiversity



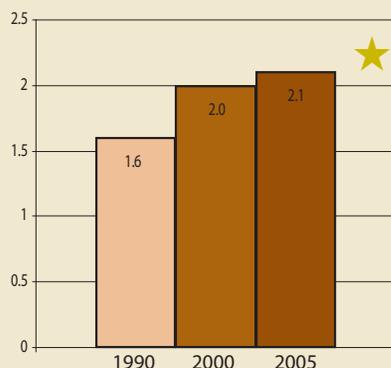
Progress Towards Sustainability

As defined by the United Nations Millennium Development Goal 7 indicators

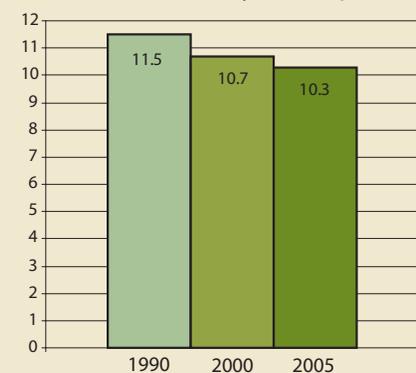
Wood is Mali's primary energy source. Overcutting for fuel is a serious problem that has resulted in the decline of forested area. The major environmental problem in Mali is increasing desertification. Mali—with one national park, four animal reserves, and six forest reserves—shows some improvement in the percentage of protected area to total surface area.

★ Indicates progress

Protected Area to Total Surface Area in per cent



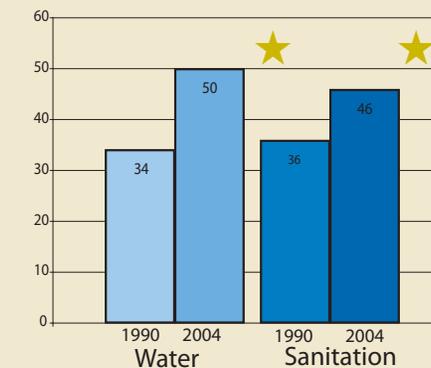
Land Area Covered by Forest, percentage



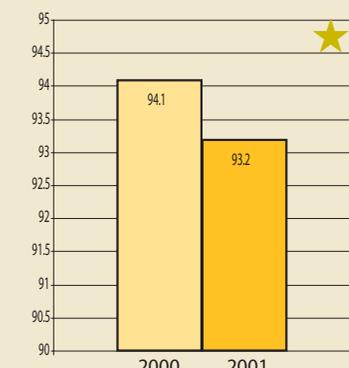
Carbon Dioxide Emissions (CO₂), Metric Tonnes per Capita (CDIAC)



Access to Improved Water Source and Sanitation (per cent of total population)



Slum Population as per cent of Urban Population



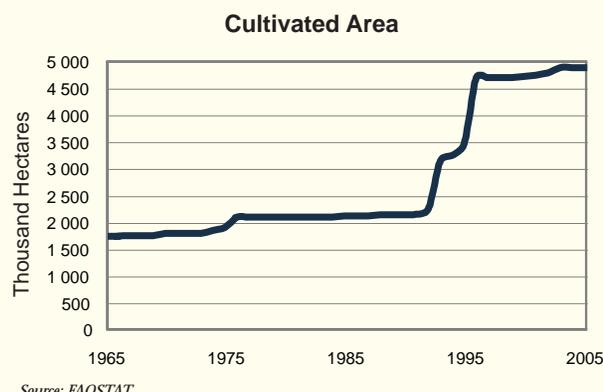
The Dogon people of Mali use an endemic plant (*Acridocarpus monodii*) as an effective remedy for malaria and various other illnesses.

Desertification and Drought

Prolonged drought is the greatest threat to livelihoods and ecosystems in Mali, and is a leading driver of desertification when combined with increasing human pressure on land resources. Mali is among the fastest growing countries in Africa with an annual population growth rate of nearly three per cent (UNESA 2005), resulting in the conversion of an estimated 100 000 hectares of land each year to cope with rising food needs (CBD 2001).

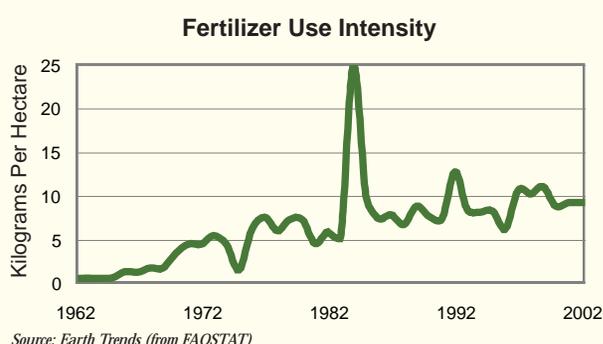
The use of fire to manage agricultural land is one of the leading causes of land degradation; an estimated 14.5 million hectares of pasture are burned each year, equivalent to 17 per cent of the country (CBD 2001). Overall, approximately 98 per cent of Mali's territory is at risk from desertification (FAO AGL 2003). The fertile areas

surrounding the Niger River are particularly vulnerable due to the high concentration of people and agriculture.



Water Availability and Pollution

Mali's water supplies, like its population and agricultural areas, are unevenly distributed. The Sahara Desert covers over half of the country, but

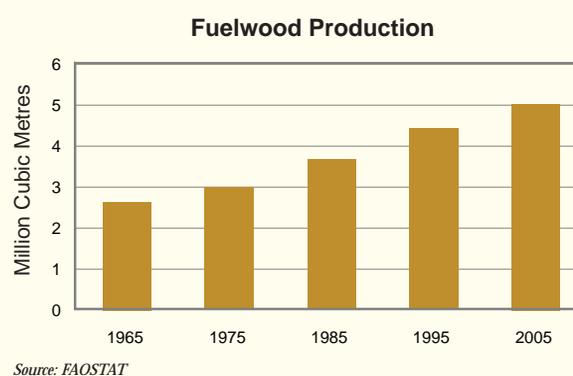


the Niger and Senegal River systems ensure that total water resources are relatively large. Only 50 per cent of the total population and 36 per cent of the rural population have access to an improved water source (UN 2007).

Pollution is another threat to Mali's water resources. Nearly all the commercial and residential effluent from the Malian capital of Bamako flows into the Niger River untreated (UN 2004). Other major sources of pollution include agricultural runoff of pesticides and fertilizer, and cyanide and sediment from gold mining activities.

Threats to Biodiversity

Due to its varied ecosystems and climatic zones, Mali supports tremendous biodiversity including over 1 700 plant species and nearly 1 000 animal species. However, biological resources are over-exploited by the growing human population. Deforestation is a major problem, especially as demand for fuelwood and charcoal continues to rise. In 1997, deforestation caused economic damage amounting to an estimated 5.35 per cent of GDP (CBD 2001). In addition, fish species are threatened by over-harvesting, the use of chemicals and explosives for fishing, and water pollution.

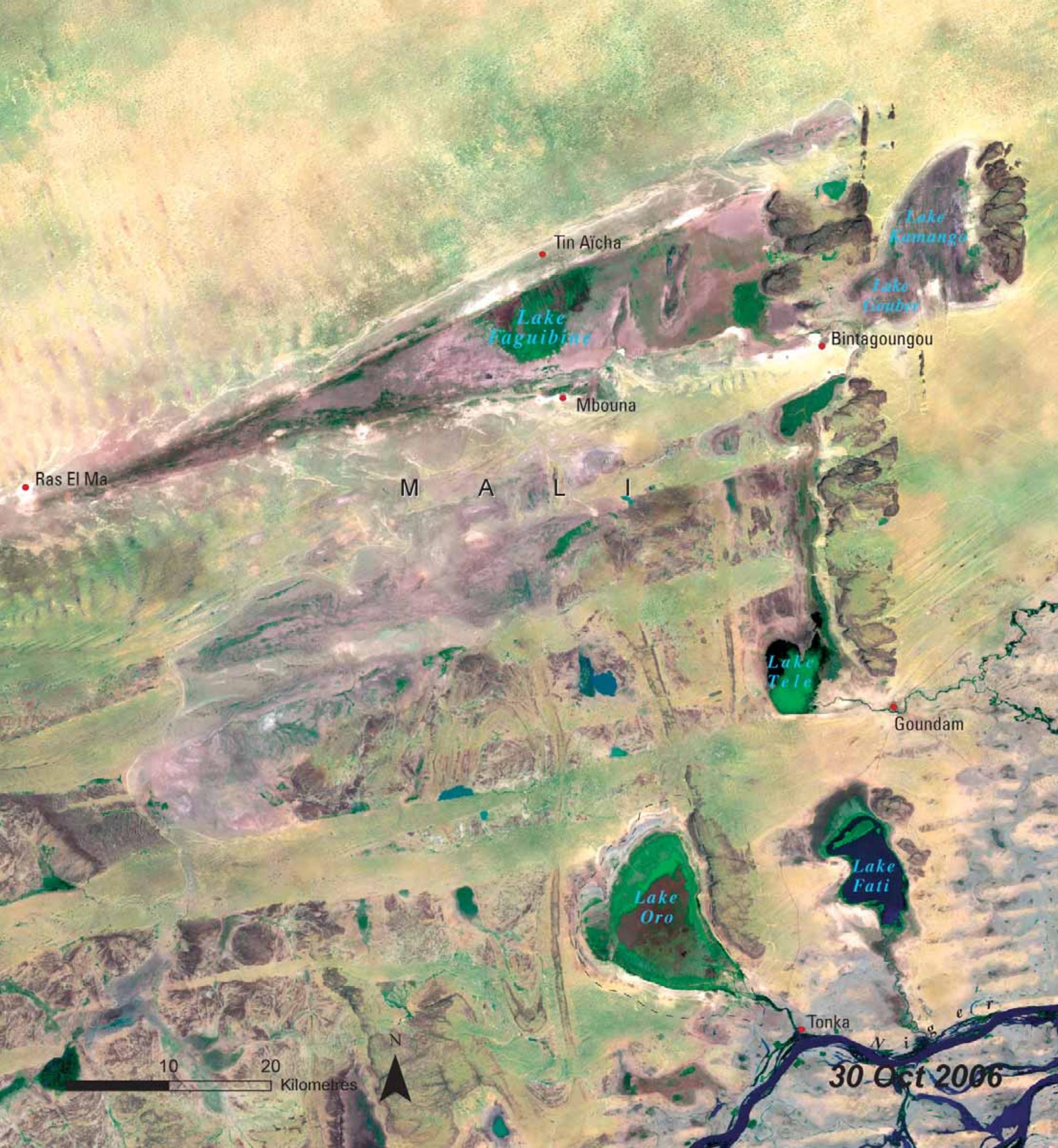




The Drying Up of Lake Faguibine: Mali

When Mali's Lake Faguibine is full, it is among the largest lakes in West Africa—it covered an estimated 590 km² in 1974—and is an important source of water for the surrounding area. The lake is at the end of a series of basins that receive water from the Niger River when it floods. Thus, water levels in Lake Faguibine are closely tied to the flow of the Niger River. A lack of rainfall in the catchments of either the lake or the river can affect water levels in Lake Faguibine.

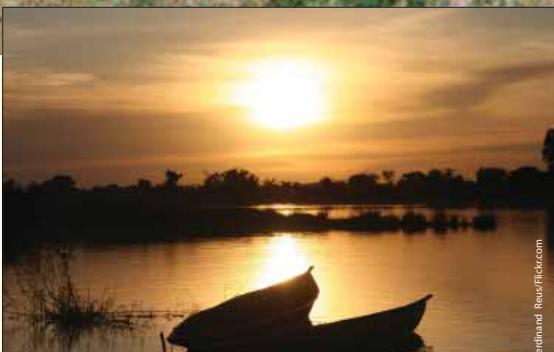
Water levels have fluctuated widely in Lake Faguibine since the beginning of the 20th century. However, in the late 1980s, an extended period of reduced precipitation led to a complete drying



up of the lake in the 1990s, making the traditional livelihoods of fishing, agriculture, and pastoralism difficult if not impossible. Despite relatively normal rainfall in recent years, Lake Faguibine remains nearly dry.

A 2003 Columbia University study linked changes in sea surface temperature to drought in the Sahel during the 1970s and 1980s. More recent research has linked sea surface temperatures to human induced global warming. As global warming intensifies, there may be more change in store for West Africa and for the people who depend on water resources such as Lake Faguibine for their livelihoods.

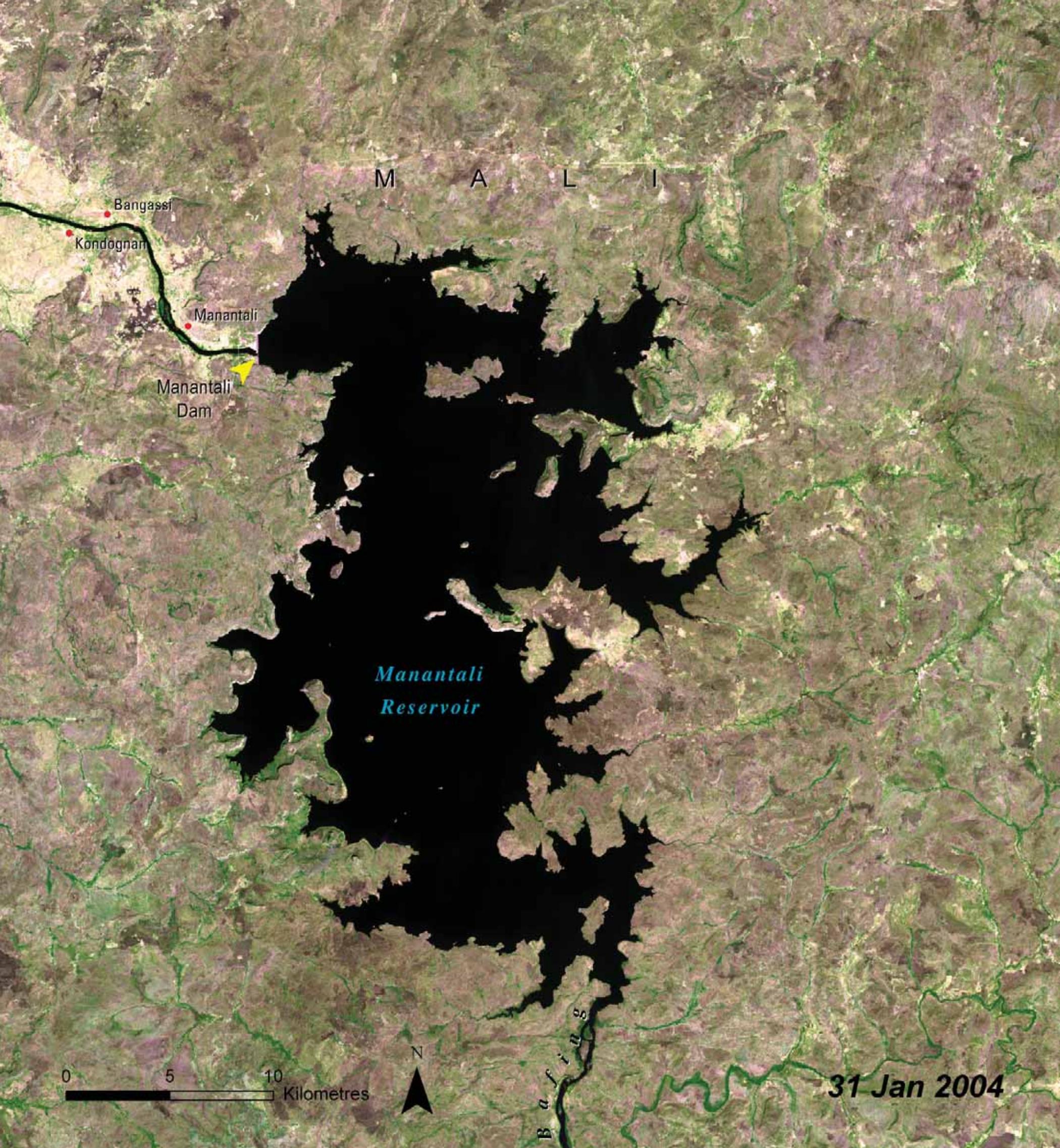




Consequences of Manantali Dam: Mali

Seasonal rainfall at the source of the Bafing River in Guinea has historically led to seasonal flooding along the Senegal River, which receives over half of its flow from the Bafing. Prior to the 1970s, this pattern of inundation provided the basis for flood recession agriculture that supported hundreds of thousands of people.

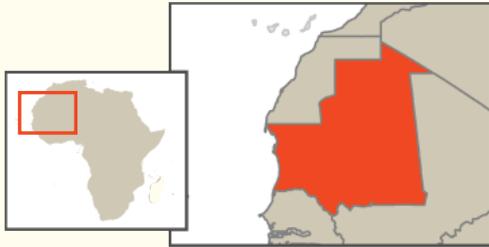
Drought in the 1970s, however, spurred the formation of the multinational Organization for the Development of the Senegal River (OMVS) to develop irrigation, power generation, and navigation. The Manantali Dam in western Mali was one of two large dams built as part of the



OMVS project. These images show the vast extent of land inundated by the filling of the dam's reservoir. Roughly 10 000 to 11 000 thousand people were displaced above the dam.

Below the dam, loss of the normal annual cycle of flood and recession reduced traditional agriculture substantially. Village-scale irrigation schemes have had limited capital for equipment and have been constructed without adequate drainage, resulting in soil salinisation. Flood recession farming was shown to give small farmers a better return with less risk than irrigated rice. Reduced flooding may also be contributing to deforestation along the Senegal River. The Manantali Dam did not produce any hydroelectric power until 13 years after its completion, and only after additional money was provided by the World Bank and others.





Islamic Republic of

Mauritania

Total Surface Area: 1 025 520 km²

Estimated Population in 2006: 3 158 000



Credit: © Flagart.com

Mauritania is a large country dominated by desert and semi-desert landscapes. Its population density is among the lowest in Africa, with an average of only one person per square

kilometre (Earth Trends 2006, FAO 2005a). The majority of the population resides in the more hospitable southern region bordering the Senegal River and in the coastal zone. Rainfall is meager and irregular throughout the country, and severe drought is common.

Important Environmental Issues

- Desertification and Deforestation
- Iron Mining
- Fisheries and Coastal Ecosystems



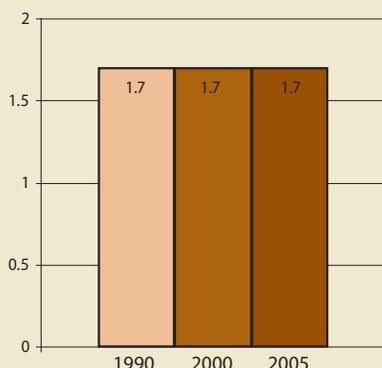
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

Mauritania is generally desert-like with three climatic regions: southern Mauritania has a Sahelian climate with one rainy season from July to October; coastal regions are arid; and about two-thirds of the country (north of Atar) has a Saharan climate. The forested area decreased by 0.1 per cent between 1990 and 2005. Even though deforestation in Mauritania is a serious problem, the protected 1.7 per cent of Mauritania's total land area has remained intact since 1990.

★ Indicates progress

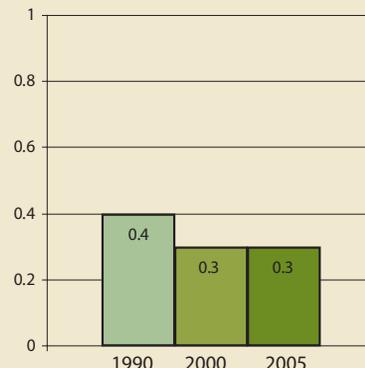
Protected area to total surface area, percentage



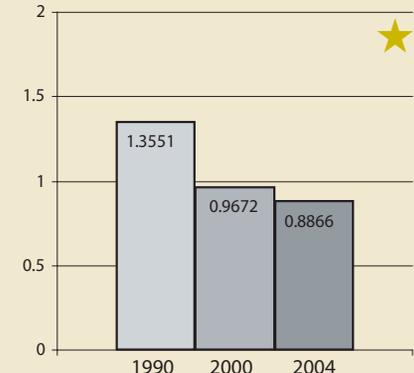
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



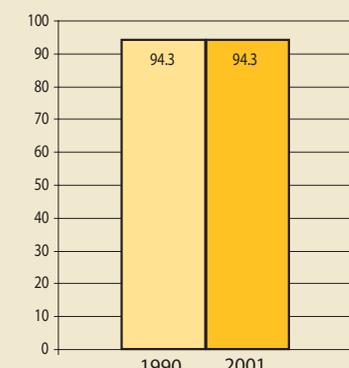
Land area covered by forest, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



Slum population as percentage of urban



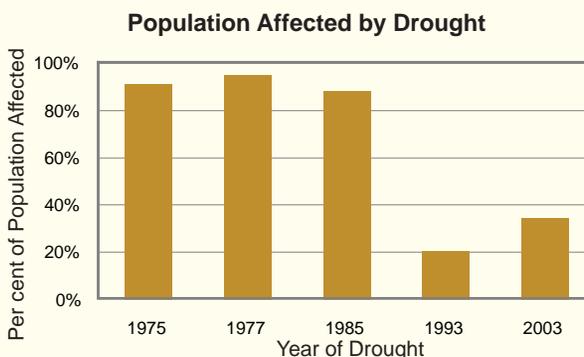
The eye of Mauritania, thought to have been caused by uplifted sedimentary rock layers sculpted by erosion, is nearly 50 kilometres across.

Desertification and Deforestation

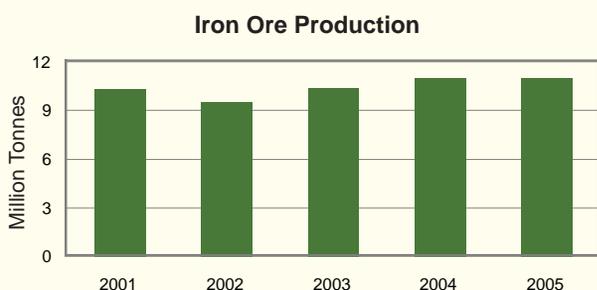
Mauritania is one of the driest countries in Africa, receiving an average of only 92 mm of rain per year (FAO 2007). The majority of the population is concentrated in the south near the country's only perennial river, the Senegal. Arable land accounts for less than one per cent of the country's total surface area (Earth Trends 2007), so livestock production is the primary agricultural activity. Years of drought coupled with overgrazing and deforestation are causing the desert to expand southward, threatening the capital city of Nouakchott and the fragile agricultural belt.

Forests cover only 0.3 per cent of Mauritania's surface (UN 2007), yet the deforestation rate is high at 3.4 per cent per year (FAO 2005b). The remaining

forests provide an important buffer against the advancing Sahara Desert, but are threatened by growing demand for fuelwood and agricultural land.



Iron Mining



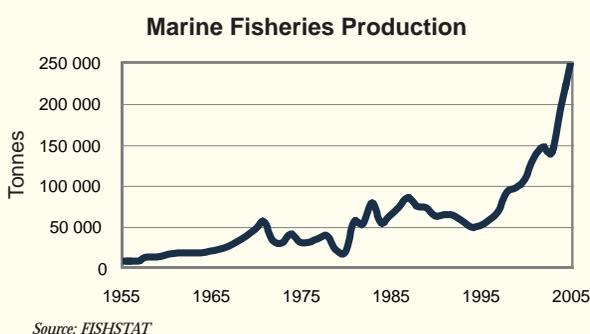
Iron ore is one of Mauritania's most important natural resources; Mauritania is the fifteenth-largest producer of iron ore in the world. Mining activities have driven rapid urbanisation in those towns associated with iron production and shipping, such as Zouirat and Nouadhibou in the northwest. Open-pit mining has resulted in severe localised land degradation as well as unsustainable exploitation of groundwater resources.

Fisheries and Coastal Ecosystems

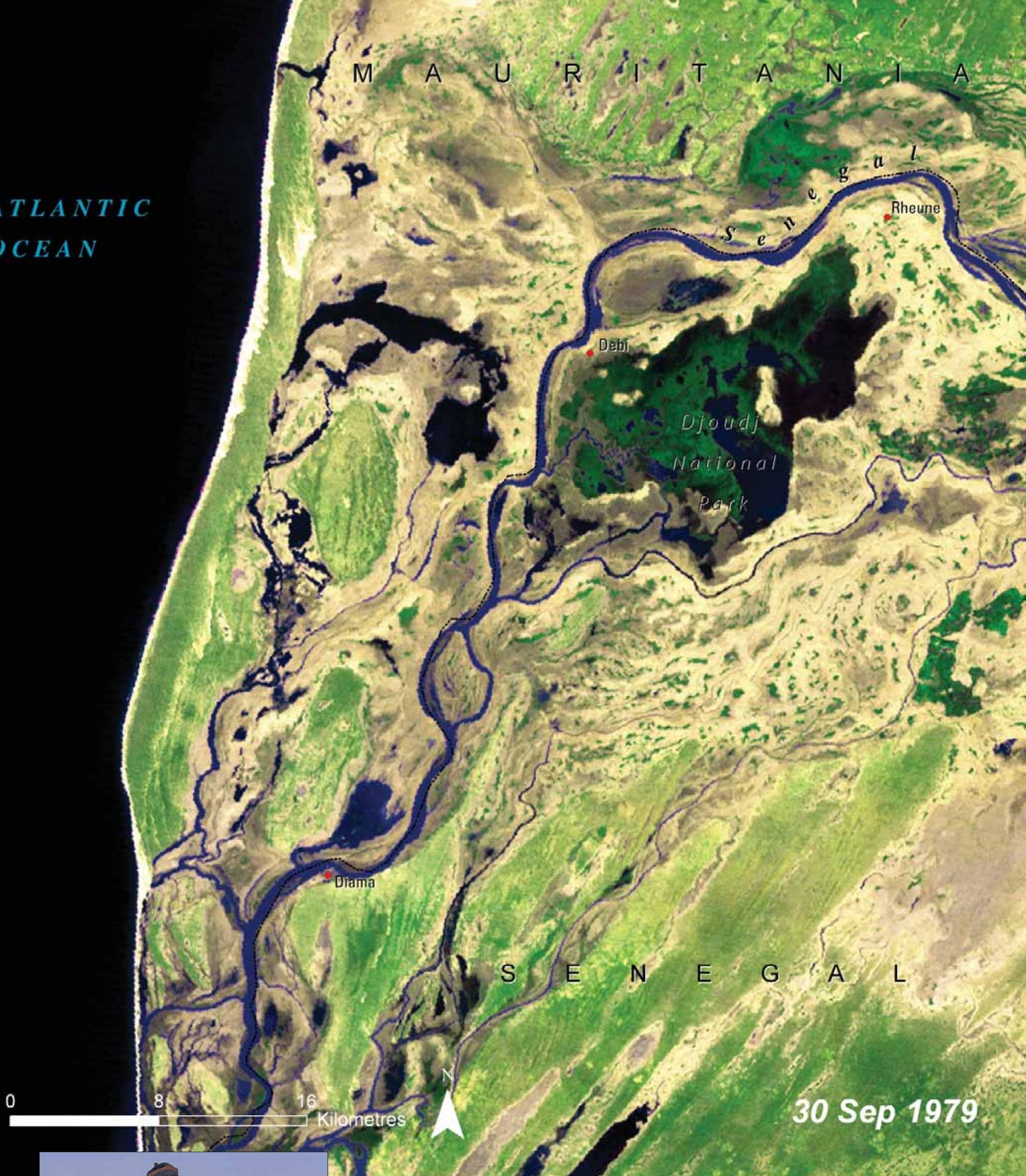
Mauritania contains the richest fishery off the West African coast, but commercial exploitation only began 25 years ago when the world iron market experienced a recession. The fisheries sector now accounts for 12 per cent of the gross domestic product, but overfishing by foreign industrial fleets, which represents 90 per cent of all production, is a growing concern (FAO 2000-2007).

Mauritania's northern coast is a unique example of the transition zone between the Sahara Desert and the Atlantic Ocean. Banc d'Arguin National Park protects this valuable wetland, which is the most

important bird breeding area on Africa's Atlantic seaboard and has the largest winter concentration of wading birds in the world (UNEP-WCMC 2002).



ATLANTIC
OCEAN



Chrisna Youny/Pikaz.com

Wetlands around Diawling National Park: Mauritania

Prior to construction of Diama Dam across the Senegal River, land surrounding the Senegal Estuary was flooded with fresh water from late July to late September each year. During the dry season, these delta wetlands would become saltier than the ocean, as their waters were reduced by evaporation.

This yearly cycle was disrupted by the construction of the Diama Dam in 1986 (yellow arrow). Both the Diama Dam, and the Manantali Dam constructed upstream in Mali, were intended to regulate the flow of the Senegal River, generate hydroelectric power, and facilitate development

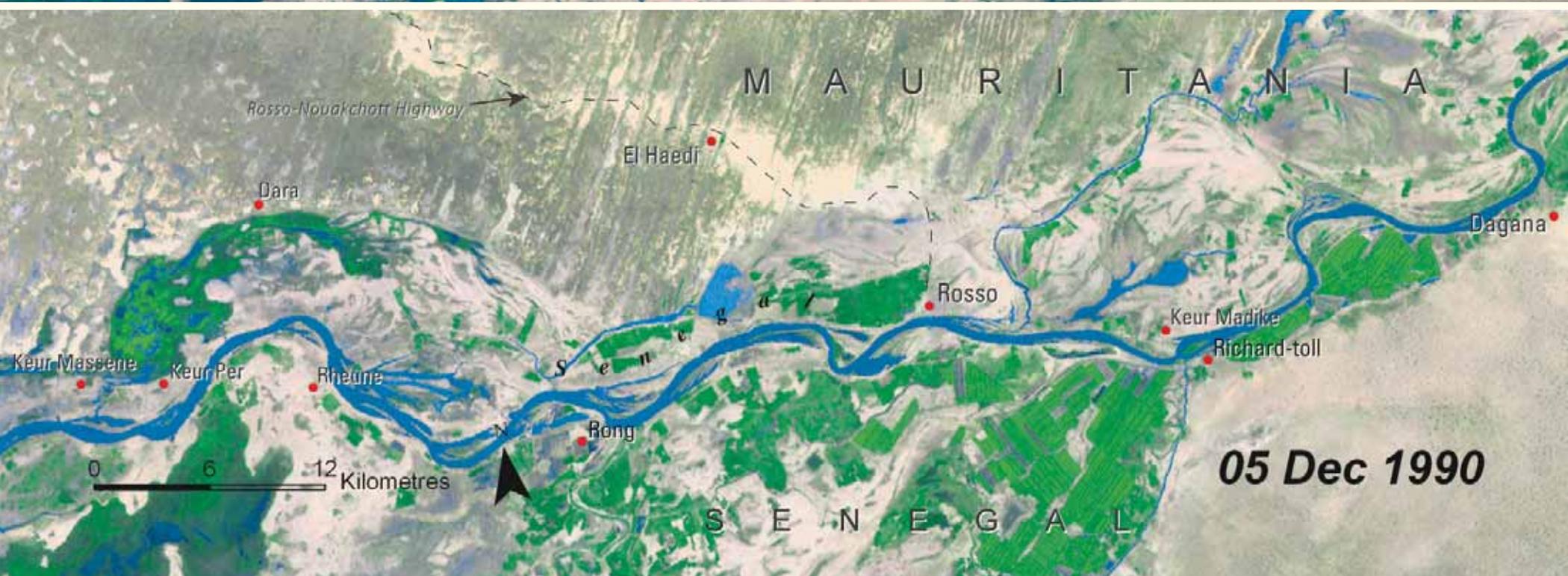
ATLANTIC
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of irrigated agriculture. However, irrigation in the delta has been less successful and less productive than planned; lacking proper drainage systems, the land is becoming waterlogged and saline after just a few years under irrigation.

Drought had already begun to impact the wetlands before construction of the dams in the 1980s (1979 image). Following their construction in the 1980s, fish stocks decreased and wetland vegetation was decimated. In the early 1990s, a restoration project began using controlled flooding of the delta by managed water releases. It has revived the wetlands and restored much of the lost flora and fauna to the area. The 2006 image shows the restored wetlands in and around Diawling National Park.

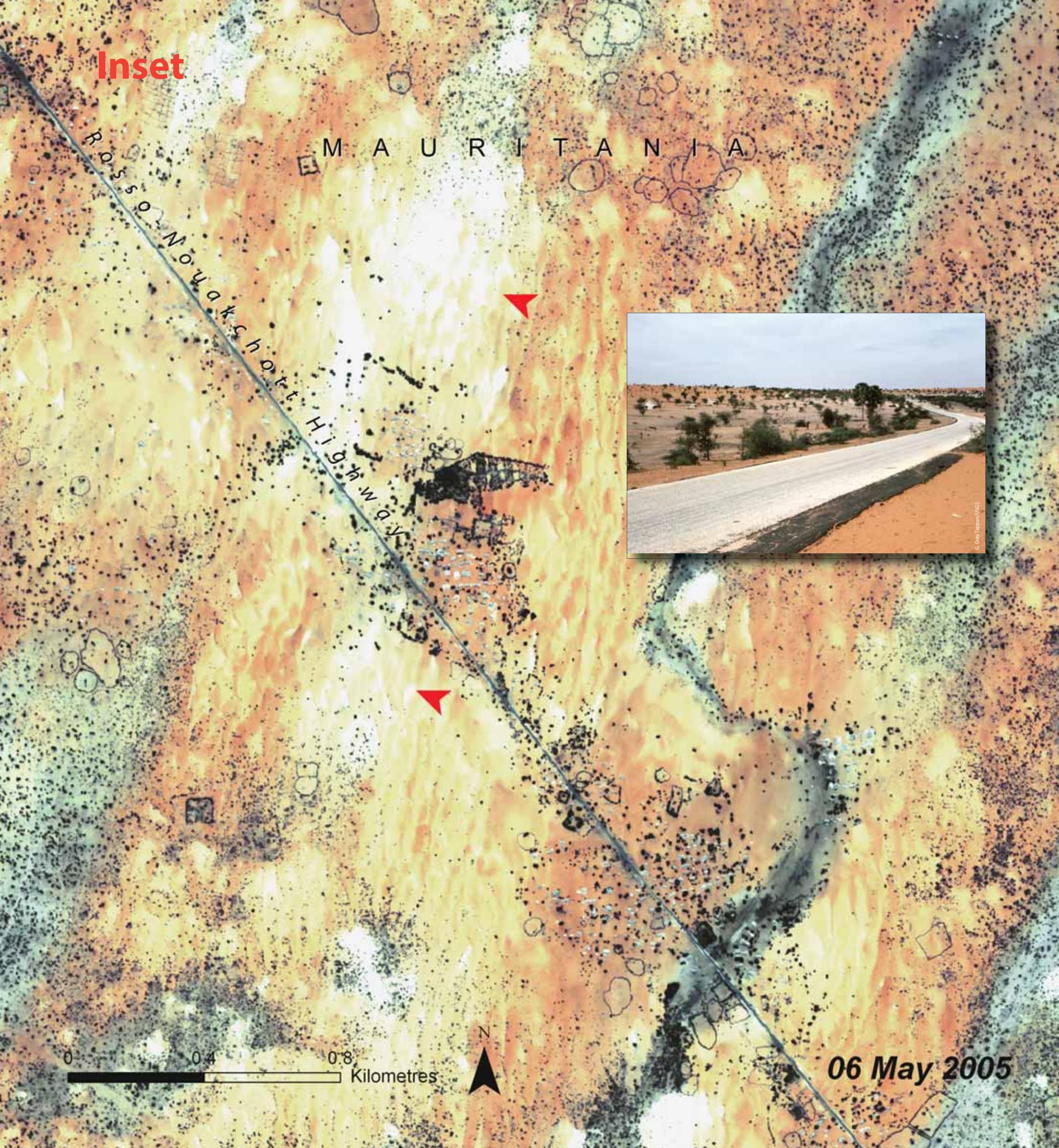




Along the Rosso-Nouakchott Highway: Mauritania

North of the border between Mauritania and Senegal, National Highway 2 connects Mauritania's coastal capital Nouakchott with the regional capital of Rosso. The highway has brought increased settlement to this arid area, leading to the loss of natural vegetation for building, grazing, and fuel, and beginning the process of desertification. Without vegetation to retain water and decrease wind erosion, the fertility and productivity of the soil declines, dry sandy soil begins to drift, and vegetation is less able to reestablish itself.

Inset



The signs of progressive degradation of the land along the Nouakchott-Rosso Highway can be seen in these images. In the 1972 image, bright reflection from the sandy soils surrounding the highway is mixed with some vegetation (shades of green). In the 1990 image, the path of the highway shows as a bright yellow corridor from northwest to southeast through El Haedi. The 2006 image shows the same pattern of vegetation loss along the highway.

The 2005 high-resolution image is an enlarged view of the outlined area (red box) on the 2006 image. Red arrows on the 2005 image indicate areas of almost total vegetation loss. Continued population growth is increasing the demands made on this arid landscape.



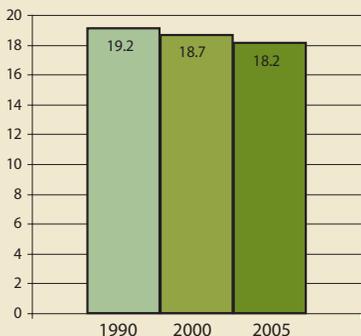
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goals 7 Indicators

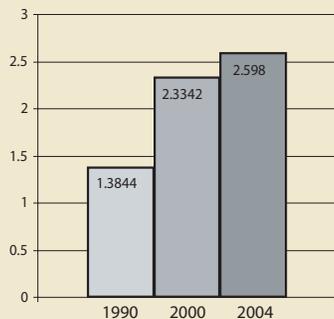
Sugar cane is the major crop of Mauritius, occupying 70 per cent of its cultivated land. The 100 per cent access by Mauritius' inhabitants to improved water sources is attributable to the country's actions to improve water quality over the past decade.

★ Indicates progress

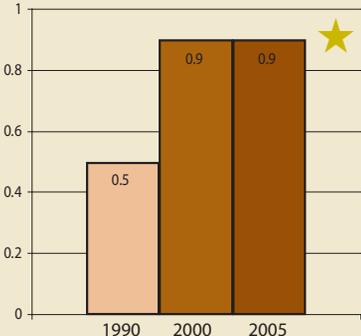
Land Area Covered by Forest, percentage



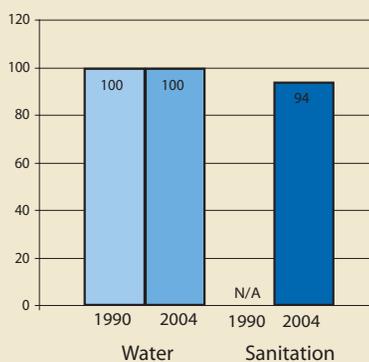
Carbon Dioxide (CO₂) Emissions, Metric Tonnes per Capita (CDIAC)



Protected Area to Total Surface Area in per cent



Access to Improved Water Source and Sanitation (per cent of total population)



Slum Population as per cent of Urban Population



Republic of

Mauritius



Total Surface Area: 2 040 km²

Estimated Population in 2006: 1 256 000



The Republic of Mauritius consists of six small islands in the southwestern Indian Ocean. The largest of these, the Island of Mauritius, is formed by an ancient volcano and is ringed by coral reefs. Over half of its population lives in rural areas, and with a population density of 652 people per square kilometre, it is the most densely populated country in Africa (PRB 2007).

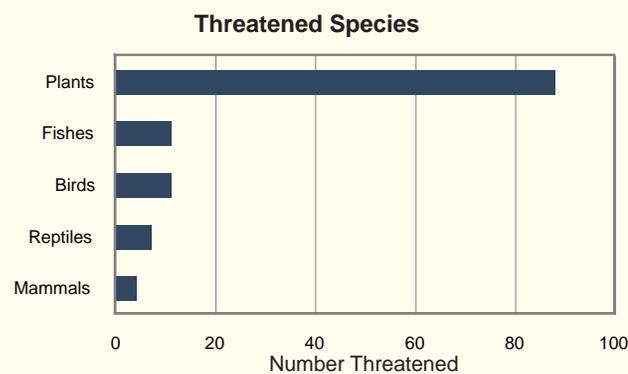
Important Environmental Issues

- Coastal Water Pollution
- Threats to Biodiversity

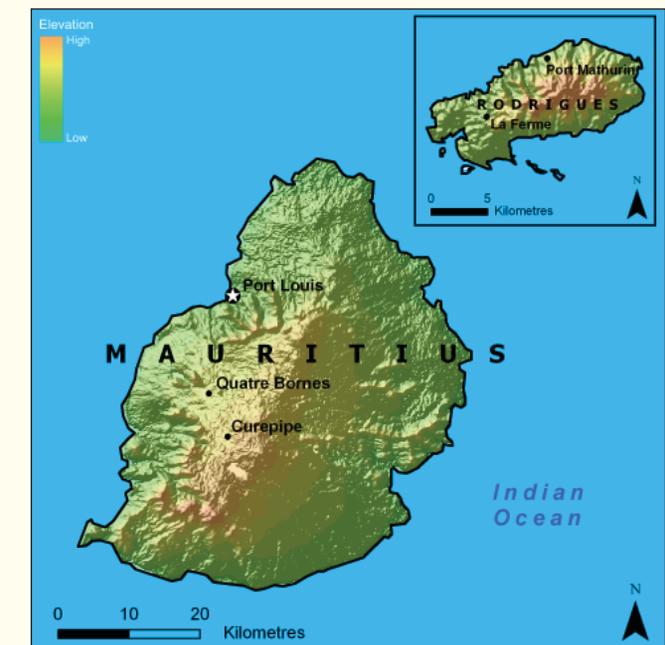
Coastal Water Pollution

Water pollution from Mauritius' large industrial and agricultural sectors poses a significant threat to its coastal and marine environments. Over half of the country's total surface area is under cultivation (Earth Trends 2007), nearly all of which is dedicated to sugar cane, the nation's most important crop. To ensure high yields, Mauritian farmers use large amounts of fertilizers, herbicides, and pesticides, all of which contribute to water pollution. Recent efforts to improve water quality are evidenced by increased wastewater treatment and a general improvement in water quality parameters since 1997 (Mauritius Ministry of Environment and National Development Unit 2006).

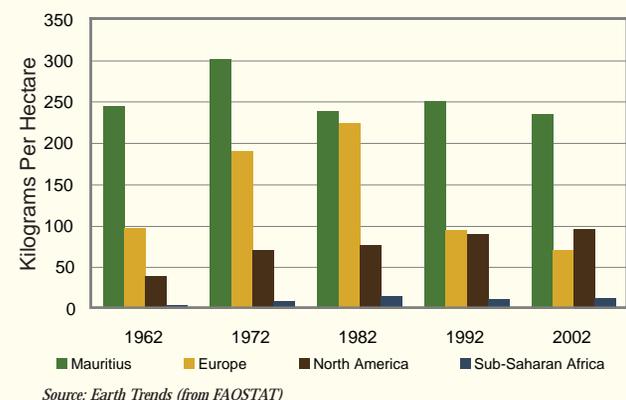
Threats to Biodiversity



Source: IUCN Red List



Fertilizer Use Intensity



Forty-one different animal species have gone extinct in Mauritius (IUCN 2007a), which is the highest number of extinctions for any country in Africa. Extinct species include the famous Dodo, a large flightless bird that succumbed to habitat loss and introduced predators during the 1700s. Mauritius' surviving species remain under threat, with 75 animal and 88 plant species listed as endangered or vulnerable (IUCN 2007b). Water pollution, deforestation, and intense population pressure are all implicated in biodiversity loss. Thanks to conservation measures, however, Mauritius has some of the most well-preserved coral reefs in the world.

Population of the Echo Parakeet (*Psittacula eques*), found in Black River Gorges National Park, increased from 10 in the 1980s to over 320 in 2000.



Threatened Coral Reefs, Mauritius

Over the past 50 years, the population of Mauritius has nearly doubled, to 1.2 million. It currently has the highest population density of any African country, 652 people per km². Mauritius has also seen a dramatic growth in its economy, which has increased demands on its environment.

Coral reefs almost surround Mauritius. Coral reefs are complex ecosystems, rich in biodiversity yet only able to survive in very clear, warm and nutrient-poor ocean waters. In these satellite images, coral reefs (yellow arrows) form a fringe along the island's shores and create shallow lagoons that are extremely important to the fishing and tourist industries. The island's population density as well as agricultural runoff, untreated sewage, changes in freshwater runoff, tourist activity, and global warming all threaten the health of the reefs.





Kingdom of

Morocco

Total Surface Area: 446 550 km²

Estimated Population in 2006: 31 943 000



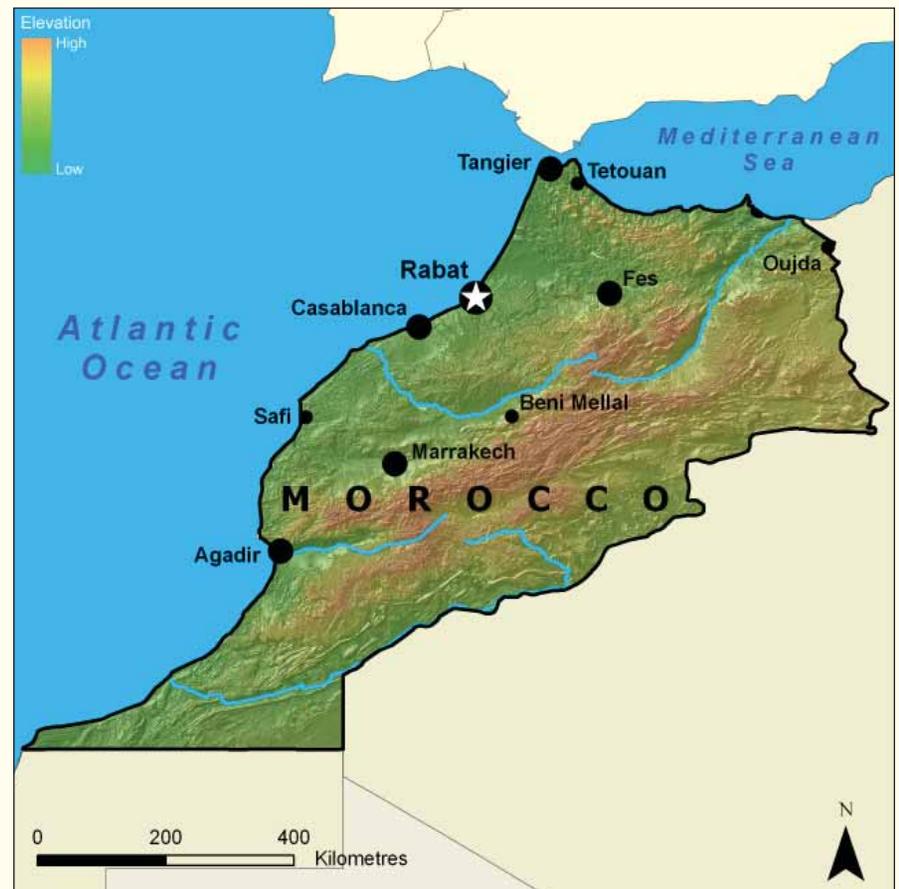
Credit: Wikipedia

Morocco's diverse geography and climate are jointly influenced by the Atlantic Ocean to the west, the Mediterranean Sea to the north, and the Sahara Desert of the interior. Over 90

per cent of the country is classified as arid or semi-arid, and the population is concentrated primarily in the sub-humid and humid zones in the northwest. Morocco's mountains are some of the highest in Africa, with the Atlas range reaching 4 165 m in some areas.

Important Environmental Issues

- Drought and Desertification
- Water Scarcity
- Pollution



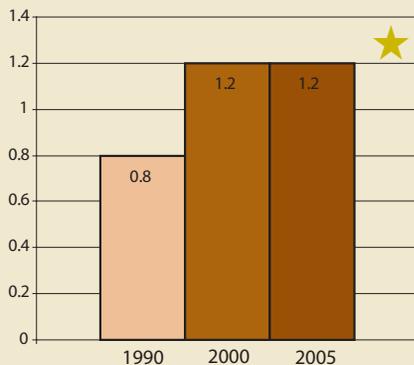
Progress Towards Environmental Sustainability

As defined by the United Nations Millennium Development Goal 7 Indicators

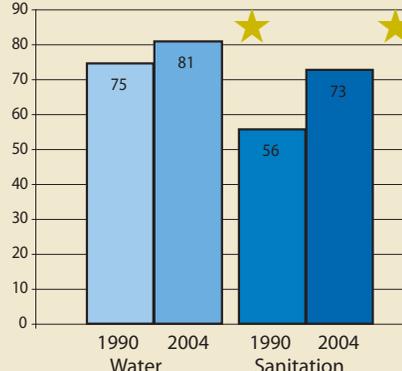
Morocco's cities produce about 2.4 million metric tonnes of solid waste per year, but a decrease in the slum population should improve this situation in the near future. Reforestation has become a major goal of the Moroccan government, which has resulted in an increase in forested area. Between 1984 and 1994, the area of forests and woodlands increased by an estimated 1 120 000 hectares.

★ Indicates progress

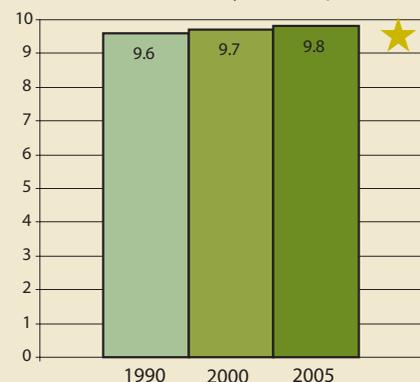
Protected area to total surface area, percentage



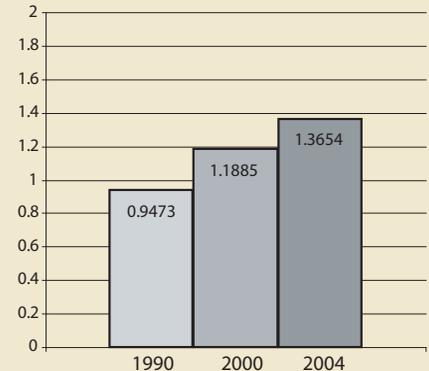
Proportion of total population using improved drinking water sources and sanitation facilities, percentage



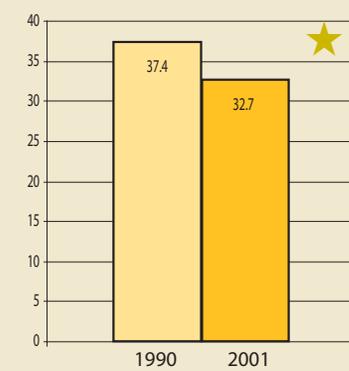
Land area covered by forest, percentage



Carbon dioxide (CO₂) emissions, metric tonnes per capita



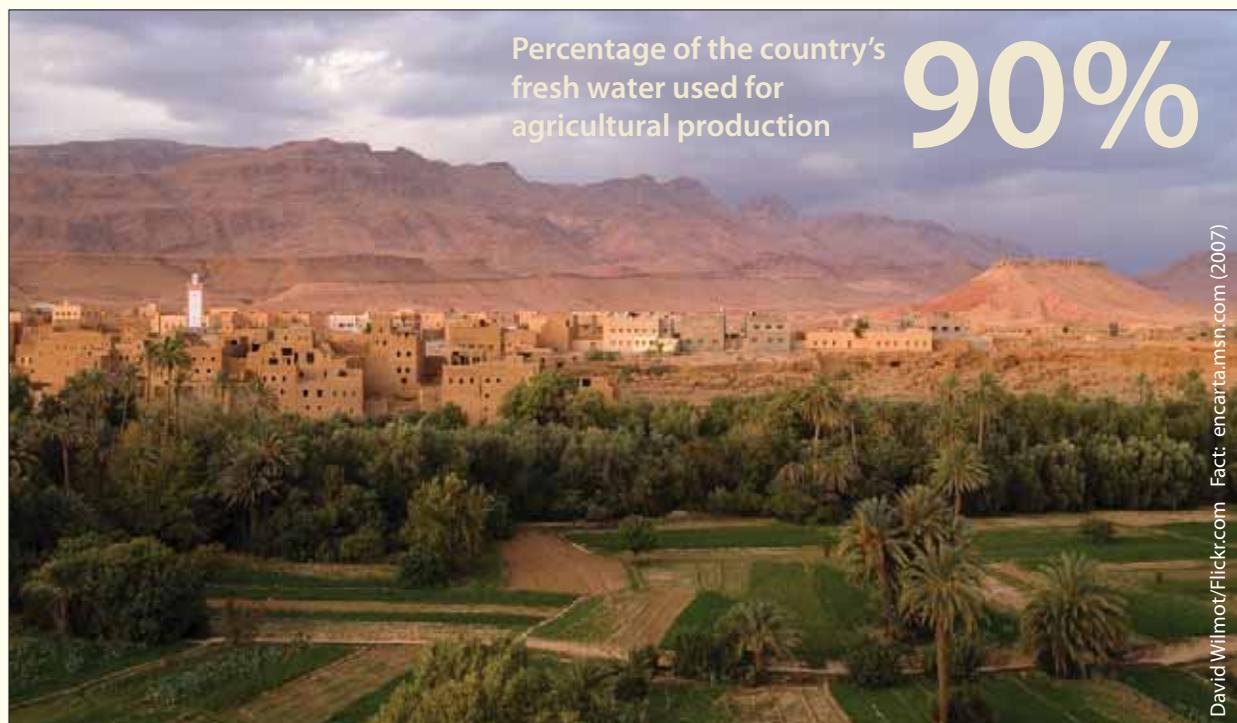
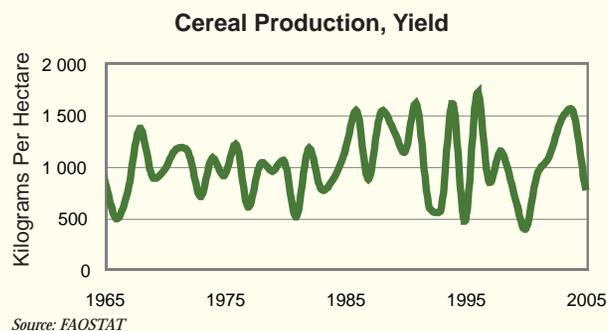
Slum population as percentage of urban



The oil-yielding Argan tree (*Argania spinosa*) is unique to Morocco and grows only in the Souss Valley of the southwest.

Drought and Desertification

Nearly 80 per cent of Morocco's lands are at high risk of desertification, and an estimated 22 000 hectares of arable land are lost each year to the desert (Ouali 2005). Since 1990, Morocco has experienced one year of drought out of every two years, compared to one out of five years during previous decades. During droughts, crop production may decrease by as much as 85 per cent, resulting in extreme annual variation in cereal yields (Karrou n.d.). Droughts also fuel wild fires that may destroy thousands of hectares of forest and exacerbate desertification.

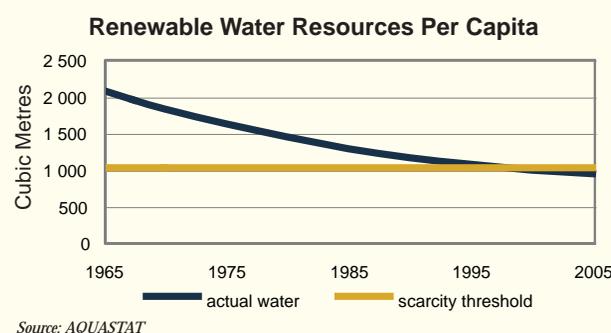


Water Scarcity

Water availability recently dropped below the international water scarcity threshold of 1 000 m³ per person per year. Surface water is unevenly distributed throughout Morocco, and although groundwater is more universally available, exploitation in several basins has surpassed natural replacement rates. By 2020, it is estimated that groundwater exploitation at the national level will exceed natural replacement by 20 per cent (FAO 2005).

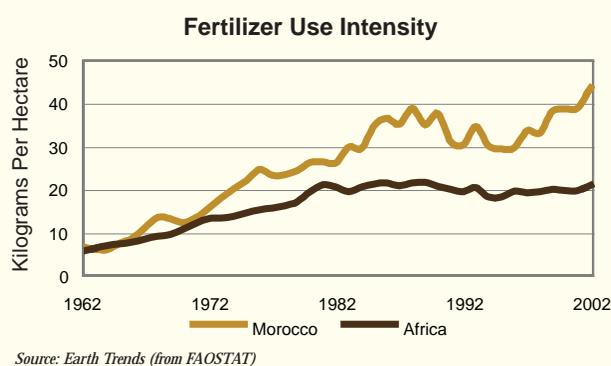
Morocco has over 100 dams providing roughly 16 000 million cubic metres of water for agricultural, domestic, and industrial purposes.

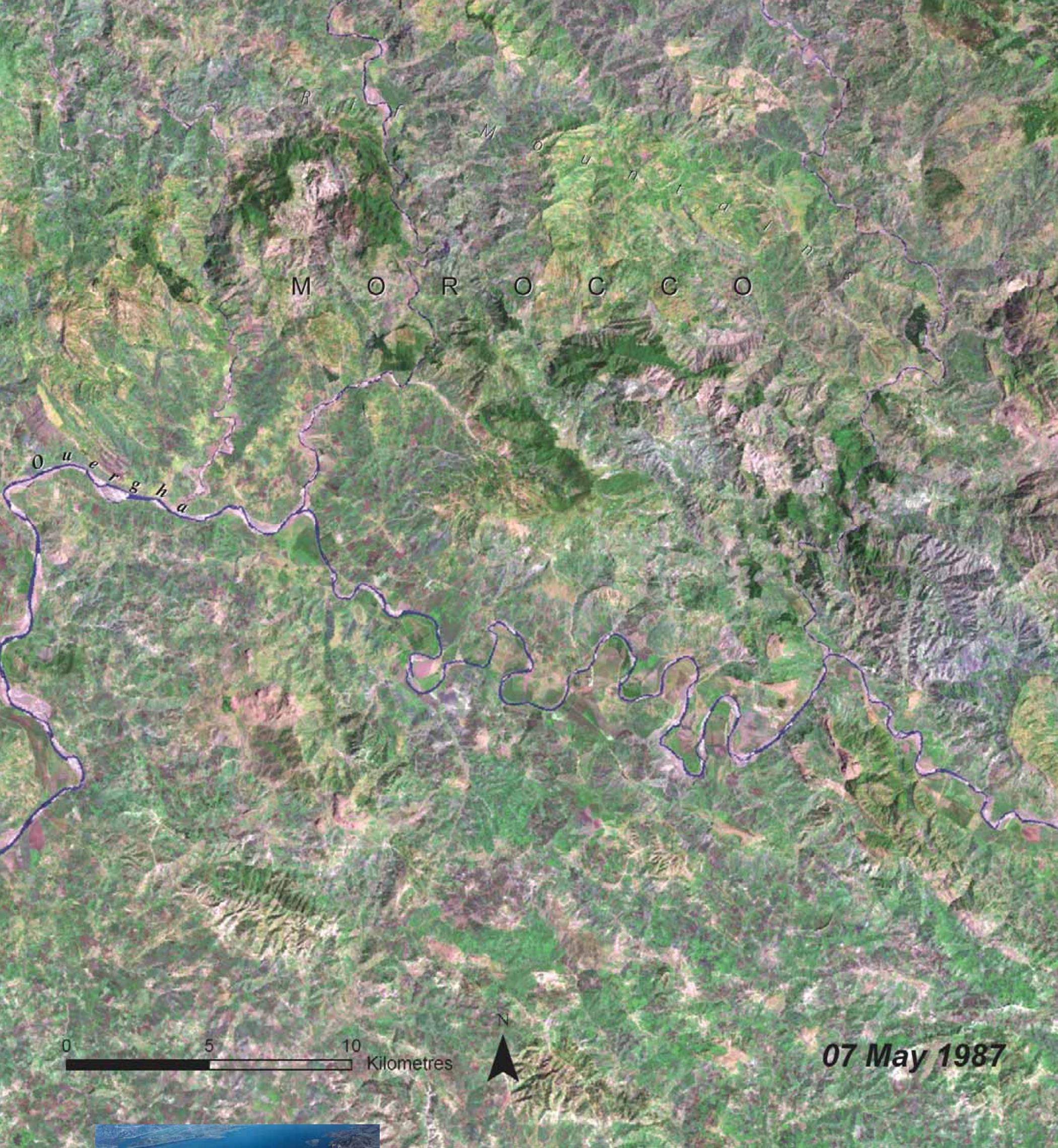
Accumulation of sediment as a result of soil erosion, however, has caused dam capacity to decline by ten per cent (FAO 2005).



Pollution

Major river basins, including the Sebou River Basin that constitutes nearly one-third of Morocco's water resources, have been heavily polluted by untreated industrial and municipal waste and agricultural runoff. Morocco's farmers are among the greatest users of fertilizer and other agricultural chemicals in Africa (FAO 2006). Wastewater generated in urban areas is often discharged untreated into the environment; 43 per cent is released into the ocean, 30 per cent into freshwater resources, and 27 per cent onto the soil (World Bank 2001).

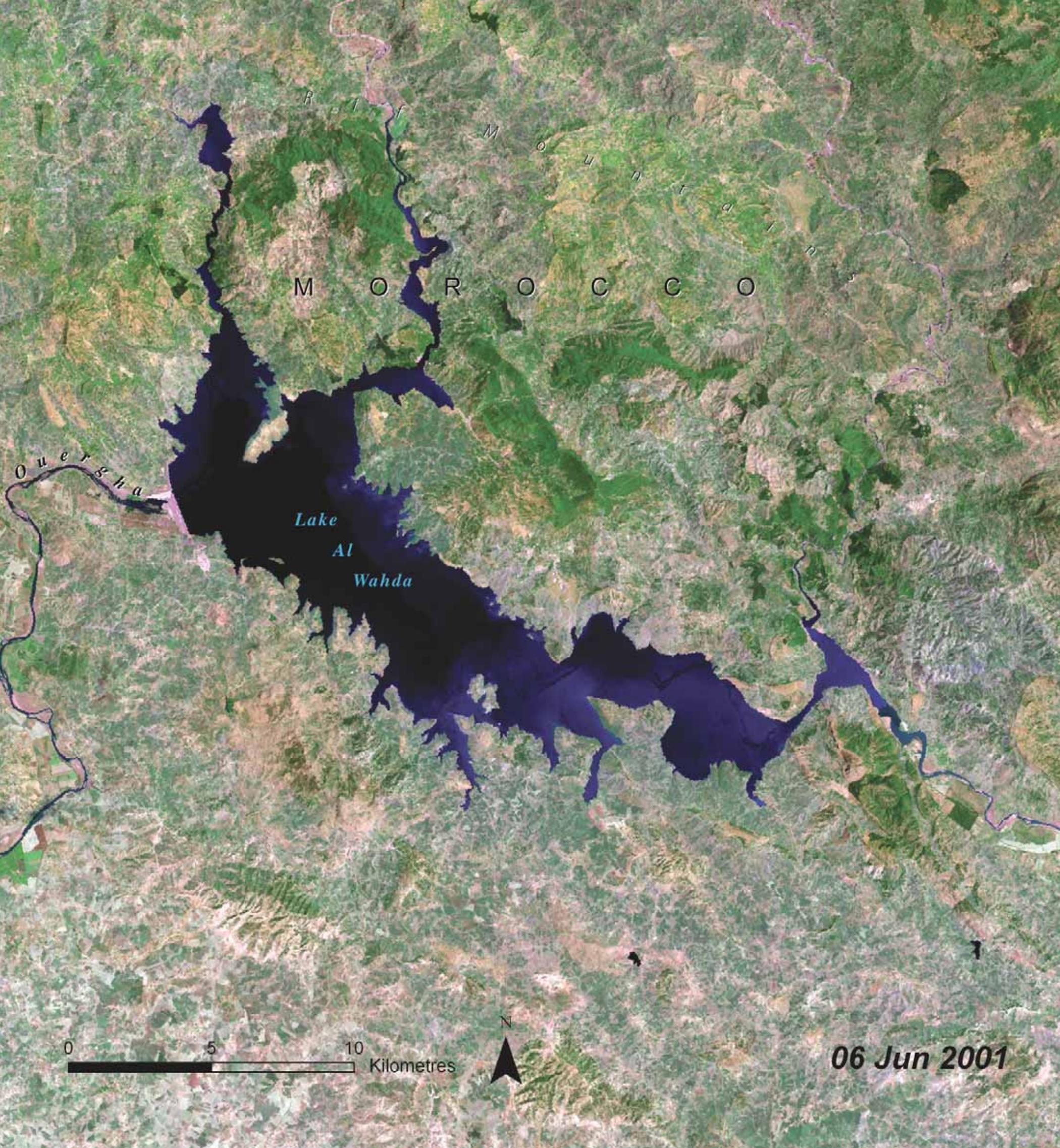




The Sustainability of Al Wahda Dam: Morocco

The second-largest dam in Africa and the largest in Morocco, Al Wahda Dam has a capacity of 9 714 million m³. Located in the Gharb Plain, the dam was built in 1996 to reduce devastating flooding along the Ouergha River, provide water for irrigation, and generate hydroelectricity.

Since completion of the dam, flooding has decreased by 90 per cent, potential irrigation has increased by about 110 000 ha, and hydroelectricity production has reached approximately



400 Gwh per year. The electricity produced by the dam allows the Moroccan government to avoid burning 140 000 metric tonnes of fossil fuels per year, thereby reducing greenhouse gases released into the atmosphere.

However, natural and human-caused erosion is filling the dam with silt and threatens its long term sustainability. It is estimated that the reservoir loses 60 million m³ of capacity each year to siltation. In addition, these sediments trapped in the reservoir do not reach the coastal estuary, which has altered the balance of siltation and erosion along the coast in favour of erosion. Another potential threat to the dam's future viability is suggested by climate and hydrological modeling, which predicts that a 1° Celsius increase in average air temperature between 2000 and 2020 might reduce runoff to the Al Wahda Dam by 10 per cent.



Atlantic Ocean

Ben Sergao

Inezgane

M O R O C C O

Souss Massa National Park

Ti n' Amara

Biougra

See Insert

5 10 Kilometres



09 Feb 1988



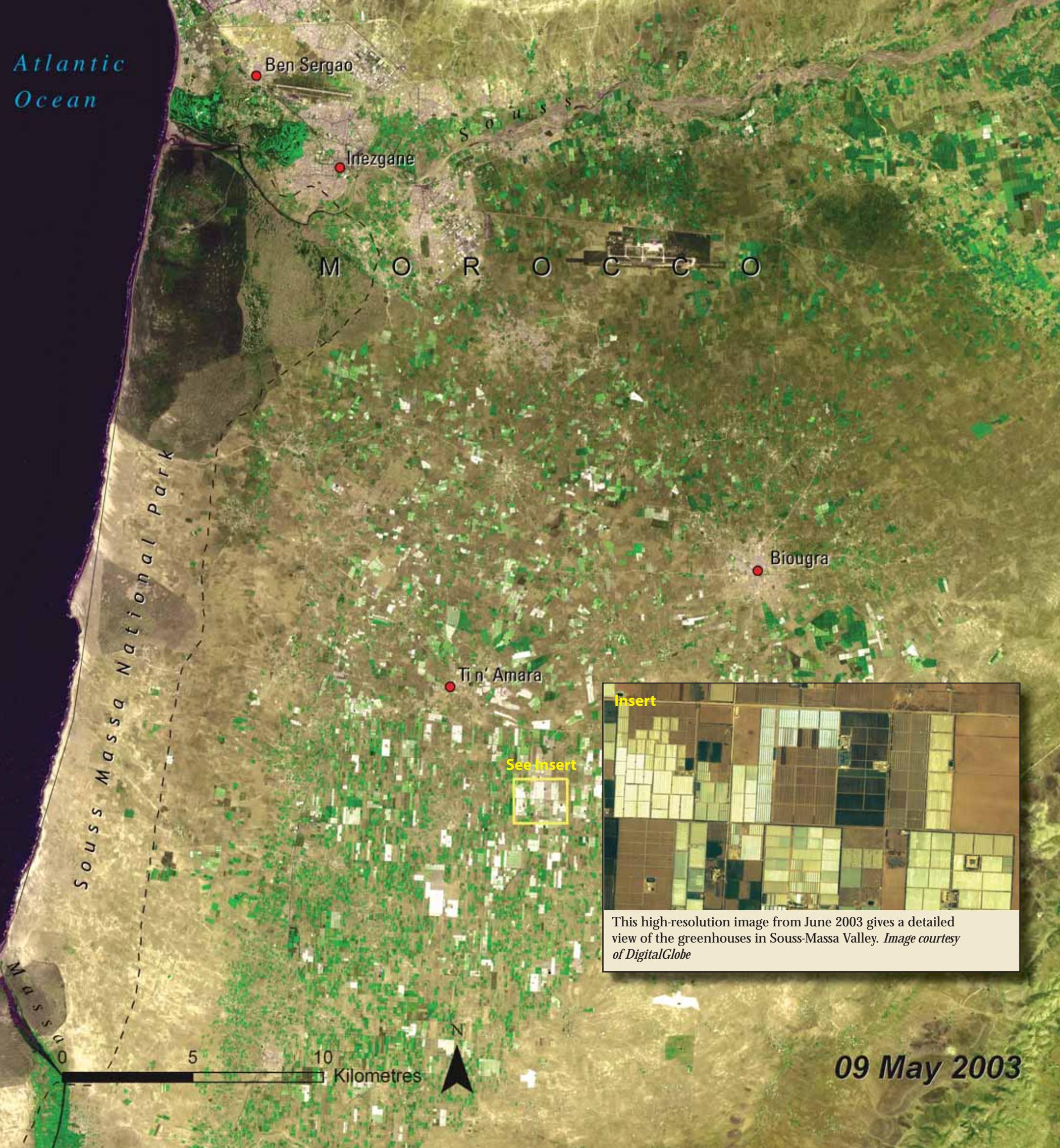
Desertification-Fighting Tree

The Argan (*Argania spinosa*) tree's long roots bring groundwater to the surface and help to fight against desertification. The species' survival is threatened by declining water levels in the Souss-Massa aquifer.

Greenhouse Agriculture: Souss-Massa Valley, Morocco

The Souss-Massa Valley is located in southwestern Morocco. Rainfall in the valley is only about 200 mm per year, which is not enough to support most types of agriculture. In 1968, Morocco's King initiated a plan to irrigate one million hectares. In 1972, the Youssef Ben Tachfine Dam (left photo) was built on the Massa River, creating a reservoir that supported a substantial growth in agriculture in the valley and allowed development of a modern agricultural area of 18 000 hectares, primarily dedicated to vegetable and citrus cultivation.





Irrigated agriculture in the valley also uses groundwater; however, groundwater withdrawal has exceeded the natural rate of recharge. Since the 1970s groundwater resources have declined, forcing farmers to drill much deeper wells to reach water.

In the 1970's, greenhouse agriculture was introduced to the area. It requires 80 per cent less water per kg of crop than unprotected agriculture. The 1988 satellite image shows a few greenhouses (light blue squares) scattered throughout the valley. The 2003 image shows the expansion that has occurred in greenhouse agriculture, with greenhouses (white squares) covering a substantial portion of the valley's agricultural land.

The Souss-Massa Valley is Morocco's leading region for greenhouse agriculture, covering 14 530 hectares in 2004. Vegetables are the primary crops, with tomatoes covering more than half the greenhouse area.





Republic of

Mozambique

Total Surface Area: 801 590 km²

Estimated Population in 2006: 20 158 000



Mozambique is a large country bordering the Indian Ocean that has many sizeable rivers and lakes. The climate is generally tropical, although precipitation varies widely from north to south and from the coast to the inland areas. Drought in the southern regions and prolonged civil war led to significant migration to coastal and urban areas, which are growing by over four per cent per year (UNESA 2006).

to south and from the coast to the inland areas. Drought in the southern regions and prolonged civil war led to significant migration to coastal and urban areas, which are growing by over four per cent per year (UNESA 2006).

Important Environmental Issues

- Water Access and Natural Disasters
- Land Use
- Protecting Wildlife and Forests



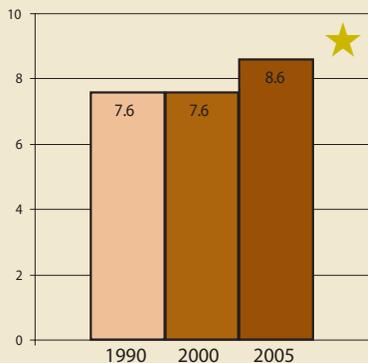
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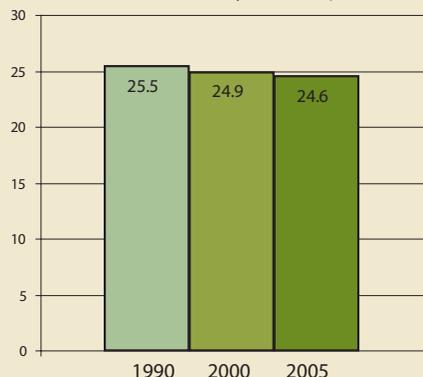
The geographical location of Mozambique favours the occurrence of floods and environmentally related diseases such as malaria and cholera, with severe negative impacts on human well-being. Mozambique lost 7.7 per cent of its forest and woodland between 1983 and 1993 alone, but has since launched reforestation projects, which have fostered denser forest cover in the wet and fertile regions; thin savannah vegetation characterizes the drier interior.

★ Indicates progress

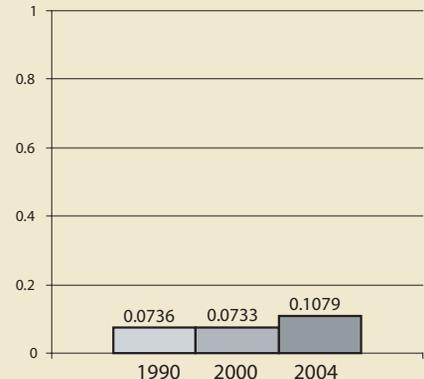
Protected area to total surface area, percentage



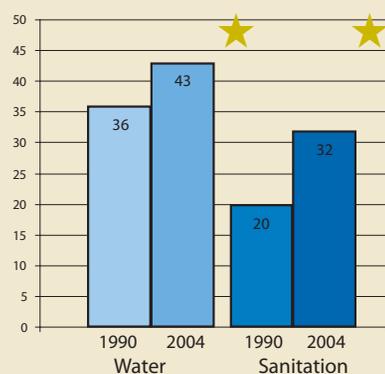
Land area covered by forest, percentage



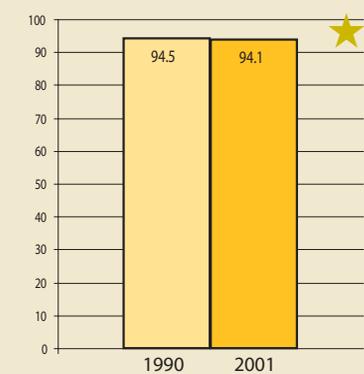
Carbon dioxide (CO₂) emissions, metric tonnes per capita



Proportion of total population using improved drinking water sources and sanitation facilities, percentage



Slum population as percentage of urban



Mozambique has roughly 5 000 km² of mangroves along its coast, the most of any country along Africa's Indian Ocean shoreline.